CHAPTER 2

EMERGENCIES

CARDIOPULMONARY RESUSCITATION (CPR)

CPR consists of a series of manoeuvres by which oxygenated blood supply to brain and vital organs is maintained during cardiopulmonary arrest (CPA), i.e. cessation of respiration and circulation.

In children, CPA is not sudden but end result of long period of hypoxaemia secondary to inadequate ventilation, oxygenation or circulation. Therefore, prompt management of these is essential to prevent CPA, the outcome of which is poor.

Diagnosis of cardiopulmonary arrest

Cardiac arrest

1. Absence of pulse in major arteries (carotid or femoral in older children and femoral or brachial in infants as carotid is difficult to palpate due to short neck).
2. Absence of heart sounds on auscultation.
3. Asystole /ventricular fibrillation on ECG.

Respiratory arrest

Absence of respiration on looking (absent chest movements), listening (absent air flow on bringing ears in front of mouth) and feeling (absent air flow on keeping hands in front of mouth or nose).

Levels of CPR. There are two levels of CPR:

1. **BLS (basic life support).** The elements of CPR provided without additional equipment. Skill and speed are most essential.
2. **ACLS (advanced cardiac life support).** Use of equipment and drugs for assisting ventilation or circulation.

BASIC LIFE SUPPORT (BLS)

Provide CPR as a team. One rescuer activates the emergency response system while a second begins chest compressions, a third is either providing ventilations or retrieving

the bag mask for rescue breathing, and fourth is retrieving and setting up a defibrillator (Figs. 2.1-2.4). Table 2.1 summarizes of key BLS components for adults, children, and infants excluding the newly born, in whom the aetiology of an arrest is nearly always asphyxial.

Call for help. Position the victim supine on firm flat surface with head level with the heart. To assess the need for CPR, the lay rescuer should assume that cardiac arrest is present, if the victim is unresponsive and not breathing or only gasping. There has been a change in the recommended sequence for the lone rescuer to initiate chest compressions before giving rescue breaths (C-A-B rather than A-B-C).

Check for response gently tap the victim and ask loudly, "Are you okay?" Call the victim's name, if you know it. If the victim is responsive, he or she will answer, move, or moan. Quickly check to see, if there are any injuries or needs medical assistance. If the victim is unresponsive and not breathing (or only gasping), begin CPR.

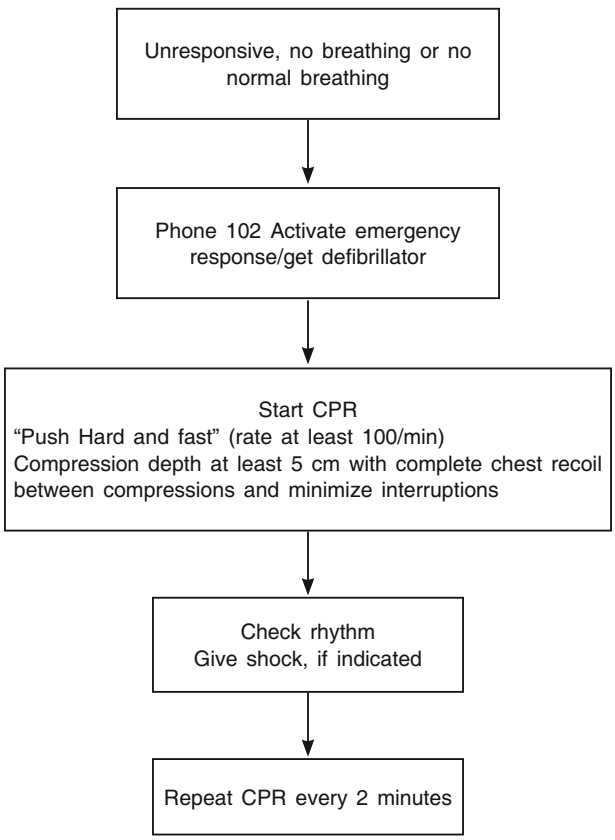
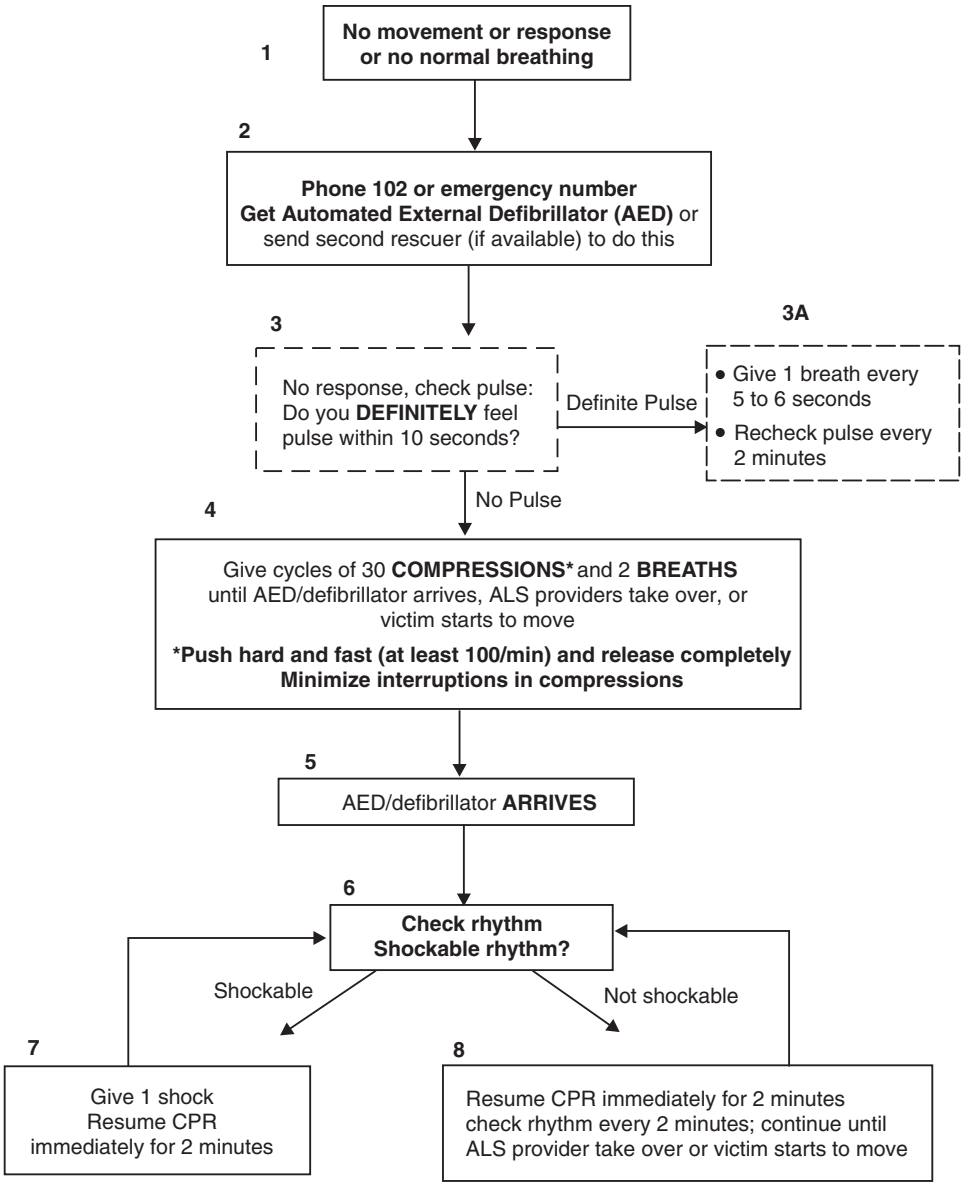


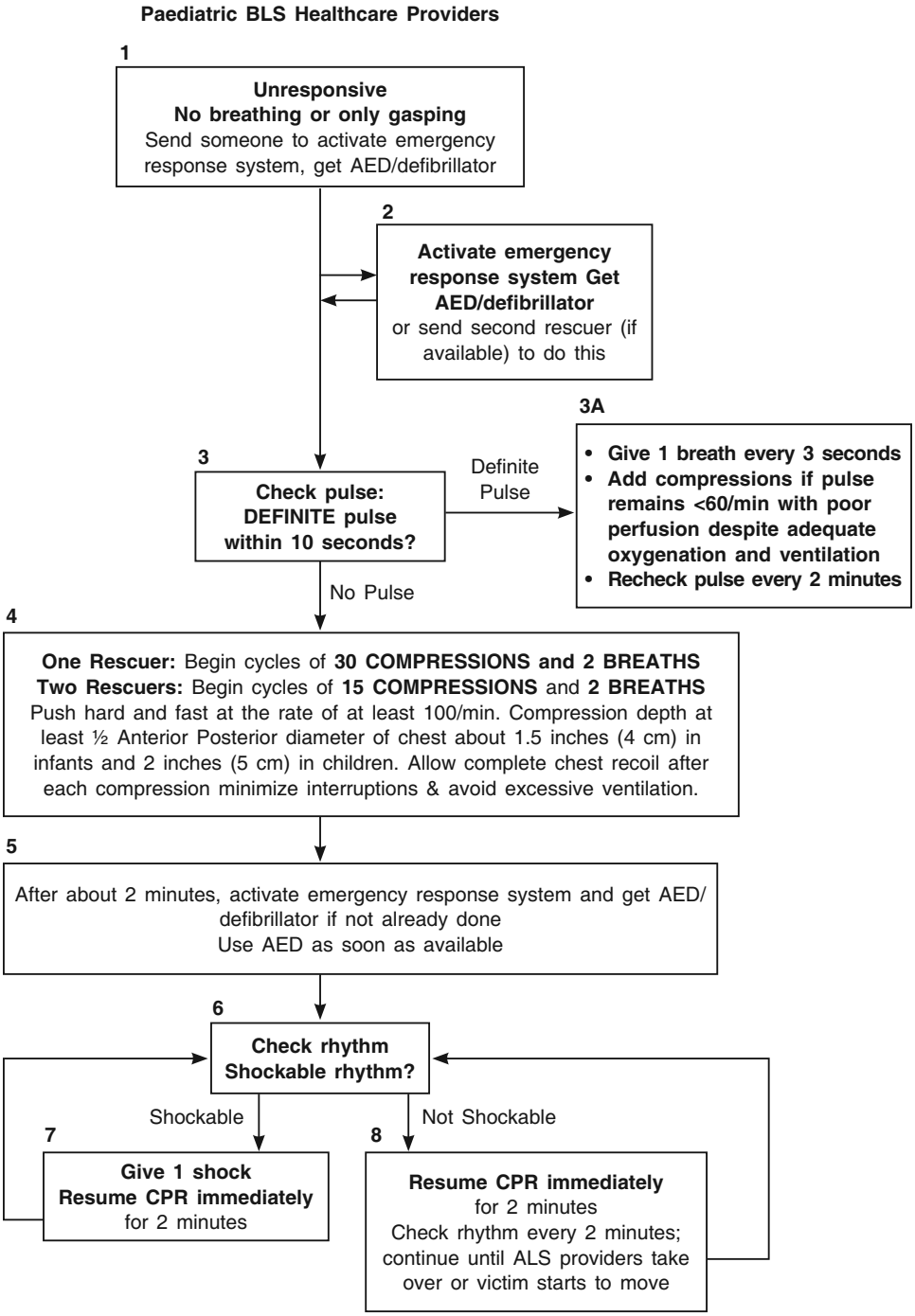
Fig. 2.1. Simplified adult BLS.



* Compression depth at least 2 inches (5 cm)

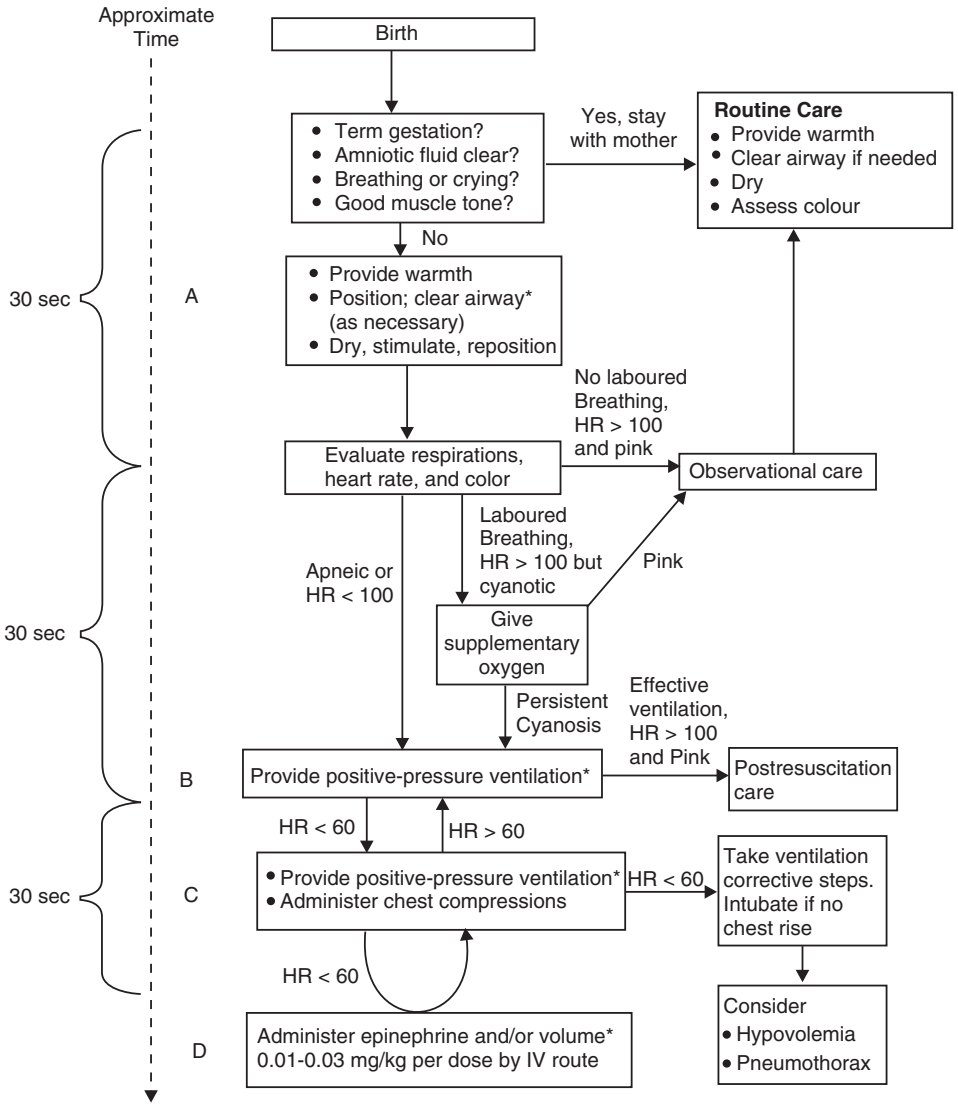
Note: Boxes bordered with dotted lines indicated actions or steps compression depth at least 2 inches (5 cm) performed by the health care provider but not the lay rescuer.

Fig. 2.2. Adult BLS healthcare provider algorithm.



Note: The boxes bordered with dashed lines are performed by healthcare providers and not by lay rescuers

Fig. 2.3. Paediatric BLS algorithm.



Note: For term babies use 100% oxygen when baby is cyanotic or when positive pressure ventilation is required. One may begin with less than 100% oxygen or room air. If so, supplementary oxygen should be available to use if there is no appreciable improvement within 90 seconds after birth. If supplemental oxygen is not available positive pressure ventilation should be continued with room air.

Medications: Naloxone not to be given by endotracheal route.

* Endotracheal intubation may be considered at several steps.

Fig. 2.4. Newborn resuscitation algorithm.

Table 2.1. Summary of key BLS components for adults, children, and infants, excluding the newly born, in whom the aetiology of an arrest is nearly always asphyxial.

Component	Adults	Children	Infants
	Unresponsive (for all ages)		
Recognition	No breathing or no normal breathing (i.e. only gasping)	No breathing or only gasping	
	No pulse palpated within 10 seconds for all ages (Health Care Provider (HCP) only)		
CPR sequence	C-A-B		
Compression rate	At least 100/min		
Compression depth	At least 2 inches (5 cm)	At least ½ AP diameter About 2 inches (5 cm)	At least ½ AP diameter About 1½ inches (4 cm)
Chest wall recoil	Allow complete recoil between compressions HCPs rotate compressors every 2 minutes		
Compression interruptions	Minimize interruptions in chest compressions Attempt to limit interruption to <10 seconds		
Airway	Head tilt-chin lift (HCP suspected trauma: jaw thrust)		
Compression-to-ventilation ratio (until advanced airway placed)	30:2 1 or 2 rescuers		30:2 Single rescuer 15:2 2 HCP rescuers
Ventilations: when rescuer untrained or trained and not proficient	Compressions only		
Ventilations with advanced airway (HCP)	1 breath every 6-8 seconds (8-10 breaths/min) Asynchronous with chest compressions About 1 second per breath Visible chest rise		
Defibrillation	Attach and use AED as soon as available. Minimize interruptions in chest compressions before and after shock; resume CPR beginning with compressions immediately after each shock		

(a) Circulation

Initiate chest compressions before ventilation. If a bystander is not trained in CPR, the bystander should provide Hands-only compressions only CPR for adult victim who suddenly collapses, with an emphasis on "**Push Hard and Fast**" on the centre of the chest and continue hands-only CPR until an AED arrives and is ready to use. The lone rescuer should continue this cycle of 30 compressions and 2 breaths for approximately 2 minutes before leaving the victim to activate the emergency response system and obtain an automated external defibrillator (AED), if one is nearby.

Rescuer should stand or kneel at the side of the patient so that his hips are on a level with the victim's chest.

In a **newborn,** (Fig. 2.4) 2 thumbs are positioned side by side on sternum just below the nipple line, with fingers encircling chest and supporting the back and compress sternum by 0.6-1.2 cm (120/min). For details, see section on Newborn Care, Chapter 19.

In an **infant,** compress the sternum with 2 fingers placed just below the intermammary line. 2 fingers (index, middle) to compress sternum by 1.5-4 cm at the rate of at least 100/min and do not lift the finger, when compression is released. Two thumb-encircling hands technique can also be used.

In **children,** (1- up to the start of puberty) use heel of hand on lower half sternum with long axis of heel same as long axis of sternum and compress 2 inches (5 cm) at the rate of at least 100/min.

In **adults,** the heel of one hand is placed on the lower sternum and the other hand placed on top of the first. The elbows should be locked in position with the arms straight and the shoulders over the hands. Sternum should depress by 1½ to 2 inches (5 cm) and the rate of compression at least 100/min.

Allow for complete chest recoil after each compression and minimize interruptions in chest compressions. (**Caution**: Do not exert pressure on the ribs, costal cartilages or xiphoid)

Combination of ventilation and cardiac massage

If both cardiac and respiratory arrest—Compression: ventilation = 30:2 in adults, children and infants with one rescuer and 15:2 with 2 rescuers.

Compression only CPR if unable or unwilling to provide rescue breaths, although the best method of CPR is compression coordinated with ventilations.

(b) Airway

After delivery of 30 compressions, open the airway and deliver 2 rescue breaths in case of lone rescuer

i. Clear airway by cleaning blood, secretions, foreign particles (suction, if available).
ii. Prevent posterior displacement of tongue due to muscle relaxation during CPA, by head tilt and chin lift or jaw thrust (may use an airway if available).
    Head tilt: Put a hand at forehead and tilt head back to sniffing or neutral position in an infant and little more in older children and adults.
    (**Caution**: In a patient with suspected cervical spine injury, head tilt should be avoided)
    Chin lift: Put finger of other hand under bony part of lower jaw at chin and lift chin upward.
    Jaw thrust: Place 2-3 fingers under each side of lower jaw at its angle and lift jaw upward with the elbow resting on the surface on which victim is lying.

(c) Breathing

While maintaining an open airway, look, listen, and feel for breathing within 10 seconds. Rescue breaths be given in approximately 1 second every 6 to 8 seconds (about 8-10 breaths per minute). Avoid excessive ventilation, with enough volume to produce visible chest rise. It applies to all forms of ventilation during, CPR, including mouth to mouth/nose/mask/airway breath (may use bag and mask, if available). Inhale and then make a seal around the mouth and nose together in an infant and seal mouth only in older children and adults (nose pinched with the hand used for head tilt) to exhale smoothly. Avoid delivering breaths that are too large or too forceful. Once advanced airway is in place, chest compressions can be continued at the rate of at least 100/min.

ADVANCED CARDIAC LIFE SUPPORT (ACLS)

If ACLS facility is available, shift the patient to ACLS as soon as possible. If this is not available, then continue cardiac massage till spontaneous HR is more than 60-80/min and continue artificial breathing till adequate respiratory efforts are present (good chest movement, no cyanosis or shock). The management of cardiac arrest is highlighted in the ACLS algorithm (Figs. 2.5 & 2.6).

Do not interrupt compressions and delay shock for accessing vascular access, drug delivery, advanced airway placement.

Inj. Naloxone

Indication: Narcotic overdose or poisoning and newborn resuscitation (if mother has been given morphine or pethidine during labour).

Dose and route: 0.1 mg/kg IV.

Inj. Sodium bicarbonate ($NaHCO_3$)

Not required routinely as it can cause alkalosis later and worsen respiratory acidosis by releasing CO_2 in inadequate ventilation.

Indication: Hyperkalaemia, significant metabolic acidosis (pH <7.2) or prolonged CPR.

In adults and in children: Inj. Sodium bicarbonate 1 mEq/kg stat and 0.5 mEq/kg every 10 minutes in protracted resuscitation.

Inj. Calcium

Indication: Not used routinely nowadays unless there is hyperkalaemia, hypocalcaemia or calcium channel blocker toxicity.

Dose and route: In children, 0.5 ml/kg of calcium gluconate IV. In adults, 10 ml to be given as a slow infusion under ECG monitoring.

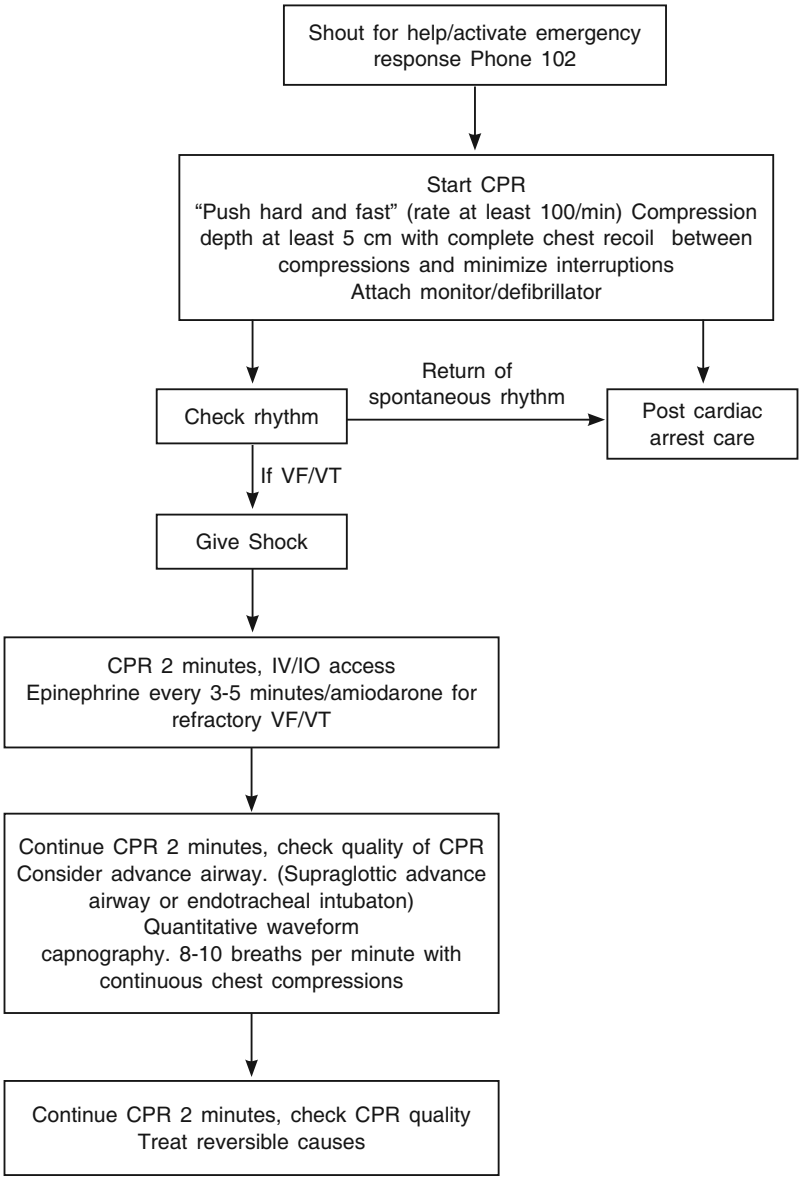
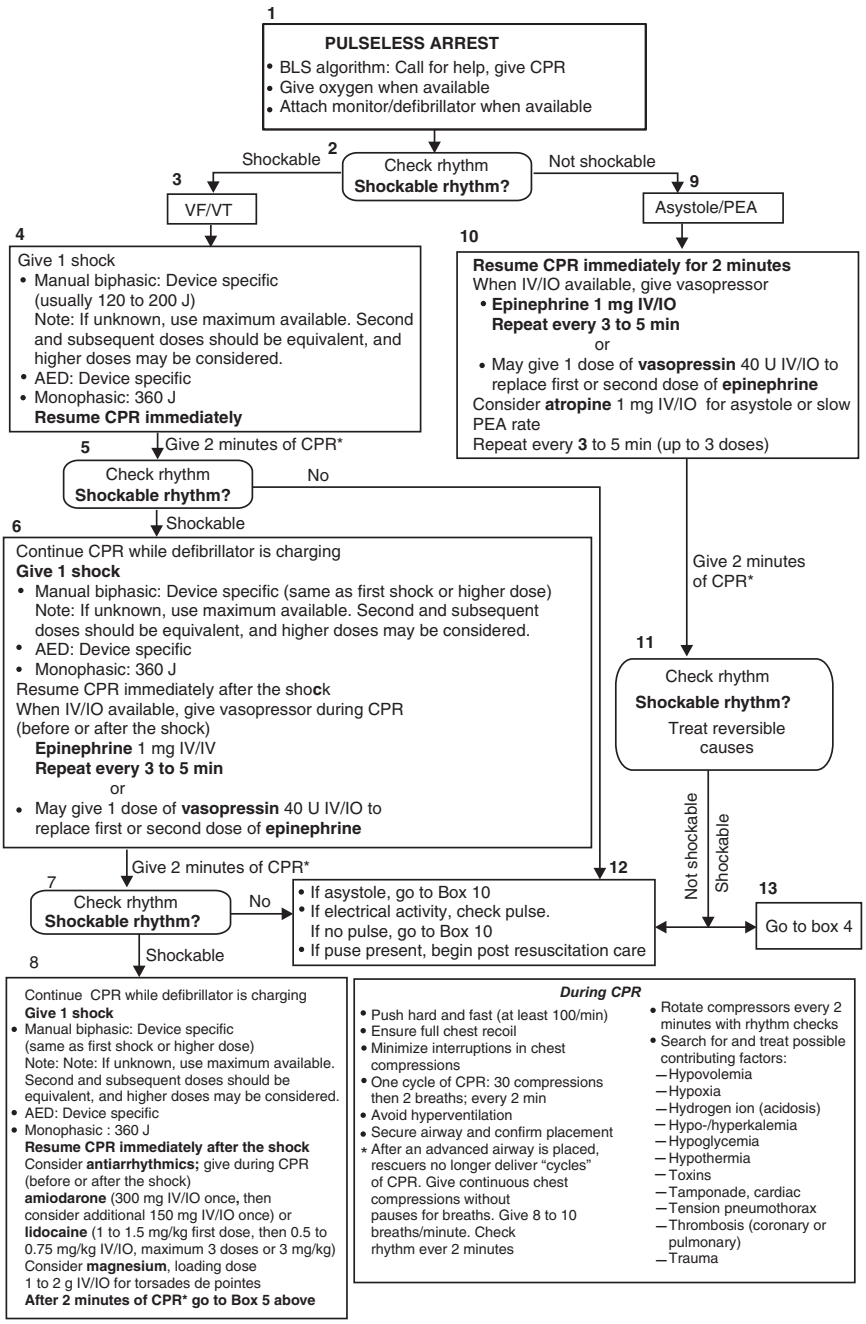


Fig. 2.5. ACLS in adults.



Reversible causes are hypovolemia, hypoxia, acidosis, hypo-/hyperkalemi tension pneumothorax, tamponade, toxins, thrombosis; VF – ventricular fibrillation; VT – ventricular tachycardia; PEA – pulseless electrical activity.

Fig. 2.6. Adult cardiac arrest algorithm.

Inj. Glucose

Indication: Hypoglycaemia.

Dose and route: 0.5-1 g/kg IV.

Try to get ABG, serum electrolytes and blood sugar (dextrose stick/ glucometer):

Post-resuscitation care.

- Optimize cardiopulmonary function and systemic perfusion, especially perfusion in the brain.
- Titrate oxygen administration to maintain arterial saturation ≥94%.
- Try to identify the precipitating causes of the arrest.
- Institute measures to prevent recurrence.
- Look for and treat seizures.
- Maintain temperature to optimize neurological recovery, fluid and electrolyte balance and ABG.
- Avoid hyperthermia. Do not actively rewarm haemodynamically stable patients who spontaneously develop a mild degree of hypothermia (> 33°C [91.5°F]) after resuscitation from cardiac arrest.
- Treat shock with fluids, dopamine, dobutamine and adrenaline infusion as required.
- Anticipate and treat and prevent multiple organ dysfunction. Avoid excessive ventilation and hyperoxia.

Monitoring

Pulse should be palpable and chest expansion should be seen during effective CPR. Blood pressure, SpO_2, Et CO_2 (in intubated patient and if facility available), ABG should be monitored during and soon after CPR.

Maternal cardiac arrest

To relieve aortocaval compression during chest compressions and optimize the quality of CPR, it is reasonable to perform manual left uterine displacement in the supine position first. Left uterine displacement can be performed from either the patient's left side with the 2-handed technique or the patient's right side with the 1-handed technique, depending on the positioning of the resuscitation team. If this technique is unsuccessful, and an appropriate wedge is readily available, then providers may consider placing the patient in a left-lateral tilt of 27° to 30°, using a firm wedge to support the pelvis and thorax.

Termination of CPR

The resuscitation team must make a conscientious and competent effort to give patients a trial of CPR and ACLS. The final decision to stop efforts can never be as simple as an isolated time interval. After 10 minutes of continuous and adequate efforts, if there are no signs of life (no heart rate and no respiratory effort), discontinue resuscitative efforts.

Patient education

- Explain to parents that many causes of CPA are preventable, e.g. injuries (by providing safe environment), poisoning (by keeping drugs out of reach of children), foreign bodies (safe toys and avoid beads, balloons, etc. and avoid eatables like peanuts in infants). Young children should be closely supervised.
- General public should be trained in BLS.
- Health care workers should be able to recognize and refer emergencies in time, and also know about BLS.

References

1. American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation 2010; 122: 18 Supplement 3.
2. Cardiovascular Collapse, Cardiac Arrest and Sudden Cardiac Death. In: Harrison's Principles of Internal Medicine. Fauci, Braunwald, Kasper et al (eds), 18th Edition, McGraw Hill Company Inc., New York, 2012; pp 2238-2246.
3. Facility Based IMNCI (F-IMNCI) Participants Manual. WHO, UNICEF, and Ministry of Health & Family Welfare, Government of India, 2009.

ANAPHYLAXIS

It is a generalized hypersensitivity reaction characterized by hypotension, peripheral circulatory collapse and respiratory difficulty in the form of stridor and dyspnoea. Anaphylaxis can occur due to food, inhaled/ingested allergens or drugs (Table 2.2). Symptoms may occur instantaneously or within a few minutes after an intravenous injection of the offending agent. At times the reaction may develop after 1/2 - 1 hour of the exposure. Anaphylaxis to oral drugs may take 1-2 hours, but in many patients it can be instantaneous.

SALIENT FEATURES

- Serious upper airway (laryngeal oedema, lower airway oedema (asthma) or both may develop, causing stridor and wheezing. Rhinitis is often an early sign of respiratory involvement. Patient can deteriorate over a brief period of time (½ to 3 hours).
- Cardiovascular collapse (hypotension) is the most common periarrest manifestation.
- Gastrointestinal signs and symptoms include abdominal pain, vomiting and diarrhoea.
- Differential diagnosis to be considered since failure to identify other conditions can be fatal are angioedema, severe, near-fetal asthma, vasovagal reactions and ACE inhibitors.

Table 2.2. Commonly used agents implicated in anaphylactic and anaphylactoid reactions

1. Antibiotics
   - Penicillin and analogs
   - Tetracycline
   - Sulfonamides
   - Streptomycin
2. Local anaesthetics
   - Inj. Lidocaine
3. General anaesthetics and muscle relaxants
   - Inj. Thiopental
   - Inj. Tubocurarine
4. Non-steroidal anti-inflammatory agents
5. Blood products and vaccines
   - Red blood cells, white blood cells, platelet transfusions
   - Gamma globulin
   - Snake and spider antivenoms
   - Rabies
   - Diphtheria
   - Tetanus
6. Diagnostic agents
   - Iodinated radiocontrast agents
7. Venoms
   - Bees, wasps, spiders, jellyfish
8. Hormones
   - Inj. Insulin · Pituitary extracts
   - Inj. Hydrocortisone
   - Vasopressin
9. Extracts of allergens used for desensitization
10. Food
    - Eggs
    - Nuts
    - Milk and milk products
    - Shellfish
    - Legumes (peanuts, soyabeans, kidney beans, chick peas)
    - Citrus fruits
11. Other drugs
    - Protamine
    - ACE inhibitors
    - Parenteral iron
    - Inj. Dextran

Treatment

A severe anaphylactoid reaction is a life-threatening emergency. Effective treatment depends on prompt diagnosis and rapid supplementation of appropriate therapy.

1. For severe anaphylaxis with shock as in all medical emergencies, initial management should be directed at the ABC of resuscitation, namely maintenance of adequate airway—suction, breathing, and circulation. If working alone, call for assistance. (For details see chapter on Cardiopulmonary Resuscitation).
2. Inj. Adrenaline 1:1000, 0.01 ml/kg (maximum 0.2 ml in children and 0.5 ml in adults) by IM injection. If necessary, dose can be repeated every 5-15 minutes. If the anaphylaxis is to injection of an allergen extract or to a hymenoptera sting into an extremity, half the dose of adrenaline can be infiltrated locally, subcutaneously after dilution with 2 ml saline.
   A tourniquet above the site slows systemic distribution of allergen. It should be loosened every 3 minutes.
   Administer IV adrenaline, if anaphylaxis appears to be severe with life-threatening manifestations (1:10,000) 0.1 mg IV slowly over 5 minutes. An IV infusion at rates of 1 to 4 mcg/min may prevent the need to repeat adrenaline injections frequency. (**Caution:** Close monitoring is critical)
3. Establish one or preferably two, wide bore intravenous lines. Commence rapid fluid resuscitation with normal saline.

4. If there is severe laryngeal obstruction, bronchospasm, circulatory shock or coma, intubate and commence intermittent positive pressure ventilation.
5. If the only manifestation of anaphylaxis is urticaria or angioedema, initial IM dose of adrenaline should be given in addition to Ranitidine. If no progression occurs, patient can be kept under observation for at least 12 hours and then discharged.

Additional measures

1. Administer Salbutamol or Terbutaline by aerosol or nebulizer, if bronchospasm is a major feature. Inhaled Ipratropium may be especially useful for treatment of bronchospasm in patients receiving beta blockers.
2. Inj. Diphenhydramine 1 mg/kg slow intravenously.
3. Inj. Ranitidine 1 mg/kg slow intravenously.
4. Inj. Hydrocortisone 2-6 mg/kg or Dexamethasone 0.1-0.4 mg/kg IV early in the course of therapy. Beneficial effects are delayed by at least 4 to 6 hours.

Supportive treatment

Removal of the causative factor such as venom. Observe vital signs frequently and if possible, monitor electrocardiogram and pulse oximetry.

All patients who have suffered a severe anaphylactoid reaction must be admitted to the hospital. Patients who remain clinically unstable after initial resuscitation should be admitted to an intensive care unit. If patient is not admitted to hospital, and if they respond to the initial treatment, provide information to them about possible late reaction.

Patient education

- To check and look for the cause (food, drugs, etc.) and to avoid it in future.
- Desensitization is effective against some of the venoms.

References

1. Urticaria and Angioedema. In: Dermatology in General Medicine. Freedberg IM et al (eds), 5th edition, The McGraw Hill Company Inc., pp.1409.
2. Facility Based IMNCI (F-IMNCI) Participants Manual. WHO, UNICEF, and Ministry of Health & Family Welfare, Government of India, 2009.
3. American Heart Association Guidelines for Anaphylaxis, Circulation 2010; 212: S829-S861.

BURNS

Burns are a major preventable cause of morbidity and mortality. These can be caused by dry heat or space heating, moist heat-scalds and fat burns, ionizing radiation, electric burns, friction, chemicals and cold-frost bite.

SALIENT FEATURES

- Burns, pain, anxiety, fluid loss and dehydration, local tissue oedema and infection.
- Early complications include shock, toxaemia, sloughing of mucous membranes-gastrointestinal tract and respiratory tract inhalation injuries, acute renal failure, and haematemesis (Curling ulcer).
- Late complications include, protein losing enteropathy, secondary haemorrhage, hypertrophic scar/keloid and contracture.

Treatment

For minor burns, as well as second-degree burns that is limited to an area of between 2 to 3 inches in diameter, follow these steps:

1. Cool the burn. This is done by holding the burn under cold running water for around 5 minutes or until the pain dips, or immersing the burned area in cold water or cooling it with cold compresses. The process of cooling the burn lessens swelling by conducting heat away from the skin. Never put ice on the burn.
2. Cover the burned area with a sterile gauze bandage: Don't use fluffy cotton, as it may irritate the skin. Wrap the gauze loosely to avoid putting pressure on the wound. Bandaging the burned skin keeps air away from the injury. This protects blistered skin and helps reduce pain.
3. Don't break or prick blisters. Broken blisters are exposed to infection.

For major burns, call for emergency medical assistance. Until an emergency unit arrives, follow these steps:

1. Check for signs that the person is alive such as a heartbeat, breathing, coughing or movement. If such signs do not exist, begin cardiopulmonary resuscitation or CPR (see section on Cardiopulmonary Resuscitation in Chapter 2).
2. Don't remove burnt clothing. However, do ensure that the victim is no longer in contact with burning materials or exposed to smoke or heat.
3. Don't immerse victims with critical large burns in cold water. Doing so may cause shock.
4. Cover the area of the burn with a moist, cool, sterilized bandage or clean, moist cloth or moist towels.

Immediate resuscitation and care in hospital

- Clear airway, suspect inhalation injury, if history of being trapped in close space, facial burns, stinging of eyebrows/nasal hairs, respiratory distress, hoarseness of voice or stridor, altered consciousness and soot in sputum.
- Check for breathing and circulation and provide support.
- Rule out other associated injuries.
- Insert nasogastric tube in all major burns.

Assess the severity of burns

Assessment includes calculation of surface area of burns: Rule of nine/charts, depth of burns, location of burns, patient's age and presence of associated injury or disease. Criteria for admission or transfer to a burns centre:

- Burns of more than 20% body surface area in an adult.
- Burns of more than 10% body surface area in a child under 10 or adult over 50 years.
- Burns of more than 5% body surface area in an infant.
- Burns of head, face, neck or perineum.
- Respiratory burns or inhalation injury.
- Circumferential burns.

Transfer should be done in a fully equipped ambulance with secured airway and circulatory support.

General Management

1. Fluid resuscitation

Intravenous fluids to be infused through a wide bore cannula (lactated Ringer's solution) at the rate of 3-4 ml/kg/% burns area. Half of the volume calculated is infused in the first 8 hours after the injury and the rest is infused in the next 16 hours (for details see respective section on fluid and electrolyte imbalance in adults and children).

Adequacy of the fluid therapy is best assessed by measuring hourly urine output, which should be maintained at 30-50 ml per hour in adults and 0.5-1 ml/kg body weight in children. Infusion rate should be increased or decreased accordingly. Other features to be assessed are pulse rate, respiratory rate, blood pressure and level of consciousness.

2. Pain relief

Cold compresses using fresh running water; avoid ice cold water. Inj. Morphine sulphate (15 mg/ml) 10-15 mg stat and can be repeated after 4-6 hours.

3. Care of the burns

- Clean the burns with running water except for the chemical burns.
- Remove cloths, dirt, and eschar.
- Dressing: Aims to minimize pain, absorb exudates and debris, shield the burns from secondary infection and provide protection during transport.
- Fasciotomy in cases of circumferential burns in extremities or chest wall.
- Application of cream—Silver sulphadiazine 1% or Silver nitrate or Framycetin 1%.
- Physiotherapy—range of action movements to prevent contracture.

4. Inj. Ampicillin 500 mg 6 hourly IV

In children, 50-100 mg/kg in 4 divided doses for 7-10 days.

Or

Inj. Ciprofloxacillin (infusion 100 mg/50 ml), 500 mg 2 times a day for 7 days.

Secondary infections are treated by appropriate antibiotics according to culture sensitivity results.

Patient is advised to attend physiotherapy: Use compression garments to prevent hypertrophic scars. Plastic surgeon's advice may be required to correct contractures.

Home management of burns

- Burnt area should be kept under running cold water. Avoid ice cold water.
- Do not puncture the bullae.
- Apply silver sulphadiazine cream 1% or Framycetin cream 1%.
- Cover with sterile dressing.
- Tab. Paracetamol 500 mg as and when required.

Scalds

Scalds may result from drinking extremely hot fluids or some irritant chemicals. In such cases, the inner side of the mouth and throat becomes red and swollen. Give cold water to drink or ice, followed by milk or egg emulsion to drink and refer the patient to a hospital.

Patient education

- Provide psychological support to the patient and relatives about the extent of burns, possible outcome and complications.
- Educate parents about prevention of accidents and burns in future by taking necessary preventive steps at home.
- Transport of patient to healthcare centre should be done at the earliest.
- The wound should be covered with a clean cloth.
- Inform the relatives about the medicolegal aspects of the injury and importance of evidence and dying declaration by the patient in case of homicidal burns or suspected dowry deaths.

References

1. Principle and Practice of Burn Management. Settle John AD (ed). Churchill Livingstone, New York, 1996.
2. First Aid During Emergency. National Portal of India. www.India.gov.in accessed on 10.9.12.

SHOCK

Shock is a state of acute circulatory failure that leads to tissue hypoxaemia.

SALIENT FEATURES

Shock is a progressive disorder which, if untreated, can lead to severe haemodynamic and metabolic deterioration finally causing multiorgan failure. Stages of shock can be arbitrarily classified as:

- **Early compensated shock:** Vital organ function is maintained by intrinsic compensatory mechanisms. Blood pressure is usually normal, there is increasing tachycardia and hypotension. The skin is cold and clammy, increased capillary refill time (>3 sec). If there is delay in treatment, it may lead to decompensated shock.
- **Decompensated shock:** There is fall in blood pressure and cardiac output. Features of peripheral poor perfusion are compounded with manifestations of vital organ impairment. Patient may have alteration of mentation (impaired cerebral perfusion), oliguria (renal hypoperfusion) and myocardial ischaemia (coronary flow impairment). Patient has acrocyanosis, cold and damp extremities and a pale look. If untreated, it can progress to irreversible state of shock.
- **Irreversible shock:** It is a term applied to the clinical situation in which even haemodynamic correction does not halt the progressive organ failure.

Classification and causes of shock

1. Haemorrhagic shock

Table 2.3. Causes of haemorrhagic shock

Traumatic	Non-traumatic
• Blunt or penetrating injury	• GI bleeds (e.g. peptic ulcer, gastric mucosal erosions, oesophageal varices, typhoid bleeds, bleeds in sepsis, DIC)
• Fractures specially of long bones and pelvic fractures	• Aortic dissection
	• Rupture of aneurysm of a large vessel, e.g. aorta
	• Erosion of a large vessel, e.g. in pancreatitis or due to tumour infiltration
	• Diffuse inflammation of mucosal surfaces, e.g. ulcerative colitis

2. Hypovolaemic shock

- Fluid loss from vomiting and/or diarrhoea, e.g. in cholera, other GI infections.
- Fluid loss in diabetes mellitus, adrenal insufficiency, excessive sweating, exfoliative dermatitis, diabetes insipidus, reaccumulation of ascites after tapping.

- Sequestration of fluid, e.g. in intestinal obstruction, pancreatitis.
- Burns.
- Crush injuries.

3. Cardiogenic

- Acute myocardial infarction.
- Cardiomyopathy.
- Cardiac arrhythmias.
- Mechanical causes, e.g. valvular disease, outflow tract obstruction, ruptured ventricular septum.

4. Distributive or vasogenic (relative hypovolaemia)

- Septic shock; toxic shock syndrome.
- Anaphylactic.
- Neurogenic.

Treatment (stepwise management)

1. Immediately start oxygen therapy 4-6 L/min.
2. Initial volume expansion measures. Venous access should be restored as early as possible (within 3-5 min). Peripheral veins should be tried first, if failed, then central veins like jugular/femoral can be used. Establish 2 wide bore IV lines and infuse crystalloids.
3. If venous access cannot be achieved in a short period, intraosseous infusion can be given into the bone marrow by putting a bone marrow needle.
4. Nature of fluids: Normal saline/Ringer's lactate (crystalloids) can be used initially in all types of hypovolaemic/haemorrhagic shocks. Colloids are used in conditions with capillary leaks, burns, dengue fever, nephrotic shock. Whole blood can be used as replacement in cases of trauma and haemorrhagic shock; packed cells are used in burn patients.
5. Volume of fluids: Boluses of 20 cc/kg should be pushed in 5-7 min to restore blood volume quickly through 3 way cannula. Features of recovery, i.e. warm skin and improved capillary filling time appear, very quickly after fluid replacement. If these do not appear, give a 2nd bolus.
6. In case no improvement is seen and facilities for monitoring CVP are not available and there are no features of over-hydration, give another bolus and start ionotrope (Table 2.3). If facilities for CVP are available, modify fluid therapy and inotropes according to CVP as given in Fig. 2.7.

Monitoring

Fluid therapy in patients with hypovolaemic shock to improve the peripheral perfusion and monitor pulse rate, respiratory rate, capillary filling time, blood pressure, sensorium

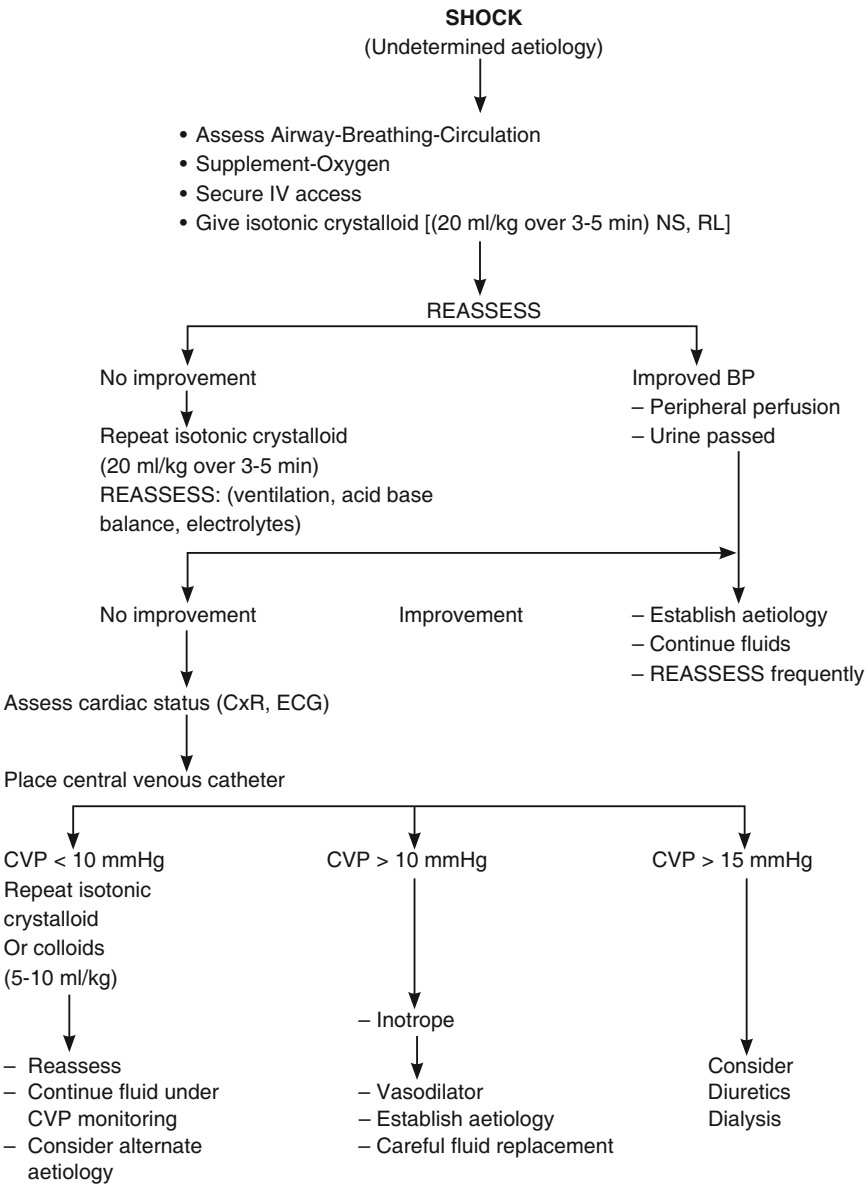


Fig. 2.7. Schematic outline of initial resuscitation of shock.

and urine output. Final end points for volume resuscitation include warm skin, re-establishment of urine output to 0.5-1.0 ml/kg/hour, adequate capillary refill (<3 sec) and heart rate and blood pressure returning to normal range for that age.

Use of Inotropes

Inotropes are used to increase myocardial contractility. These are given as continuous intravenous infusions preferably with an infusion pump. Initial therapy is undertaken with either dopamine or dobutamine. If no response, more potent agents like adrenaline and noradrenaline can be used. Dose of dopamine/dobutamine generally required is 5-10 mcg/kg/min, can be augmented to 20 mcg/kg/min (Table 2.4).

Table 2.4. Cardiovascular support drugs

Drugs	Dose	Comment
Dopamine	5-20 mcg/kg/min	Effects are dose related and complex
Dobutamine	5-15 mcg/kg/min	Selective inotrope, little chronotropic, mild vasodilator
Adrenaline	0.05-1.0 mcg/kg/min	Powerful vasoconstrictor, minimum increase in heart rate, used if other agents have failed
Noradrenaline	0.05-1.0 mcg/kg/min	Strong vasoconstrictor, mainly useful for prolonged hypotension, not responding to other agents

Note: Titrate infusion to desired haemodynamic effect.

Preparation of catecholamine infusions in infants and children can be done by following formula:

For Dopamine and Dobutamine, 6 × body weight in kg is the dose added to sufficient diluent to create a total volume of 100 ml. 1 ml/h of this fluid will deliver 1 mcg/kg/min. For adrenaline, 0.6 × body weight in kg is used in similar diluent to deliver 0.1mcg/kg/min. Response to inotropes is measured in the same way as after fluid push. If patient shows better peripheral perfusion, i.e. improved capillary filling time and warm extremities and blood pressure reaches within normal range, inotropes can be maintained for few hours, till underlying condition shows features of reversal. If patient does not show signs of improvement, should be referred to a tertiary level centre where facilities for ventilation are available.

Metabolic corrections

Metabolic acidosis as a consequence of tissue ischaemia is the most important secondary complication. Correction is indicated only when marked acidosis (pH <7.2) is present. Sodium bicarbonate 1-2 mEq/kg can be used initially but subsequent doses should be based on base deficit (mEq = body weight in kg × base deficit × 0.3).

Ventilatory support may be required in critically sick patients showing signs of ventilatory fatigue/failure.

Cardiogenic shock

Cardiogenic shock is best viewed as pump failure and common causes are acute myocardial infarction in adults and dysrhythmias in children. Immediate treatment is same as mentioned above, however, invasive monitoring and advanced life support systems are required, hence patient should be referred to a tertiary level centre after initial resuscitation (See section on arrhythmia, myocardial infarction for specific treatment).

Septic shock

Septic shock is a consequence of bacteraemia most commonly by Gram-negative organisms but Gram-positive and viral infections can also cause it. It follows trimodal pattern of haemodynamic presentation—warm shock, cold shock and multisystem organ failure.

Initial treatment is as above except requirement of volume replacement may be more and aggressive antibiotic therapy should be started early. Disseminated intravascular coagulation (DIC) is a common complication and may require fresh frozen plasma and platelet transfusion (see section on septicaemia for specific treatment).

For anaphylactic shock, see section on Anaphylaxis.

References

1. Approach to Patients with Shock. In: Harrison's Principles of Internal Medicine. Fauci, Braunwald, Kasper et al (eds), 18th Edition, McGraw Hill Company Inc., New York, 2012; 1689-1695.
2. Facility Based IMNCI (F-IMNCI) Participants Manual. WHO, UNICEF, and Ministry of Health & Family Welfare, Government of India, 2009.
3. Shock. In: Nelson's Textbook of Paediatrics. Behrman RE, Kleigman RM, Jenson HB (eds), 19th Edition, WB Saunders, 2011; pp. 305-314.

FLUID AND ELECTROLYTE IMBALANCE AND REPLACEMENT (IN ADULTS)

For life-threatening electrolyte imbalance in children, see Chapter 19.

Disturbances in fluid and electrolyte balance occur in a wide spectrum of diseases, are not confined to any particular field of medicine, and are common following burns, trauma and major surgery.

The conventional and easy method of evaluating disturbances in fluid and electrolyte balance is the frequent measurement of the concentration of serum electrolytes. It is crucial to remember that intracellular and extracellular electrolytes are normally constant, and that major shifts in and out of 'compartments' can occur in disease with minimal changes in serum electrolyte. Compositional changes also involve disturbances in acid-base balance.

Volume changes: volume deficit

I. Obvious causes

Vomiting, diarrhoea, intestinal fistulae, nasogastric suction, fluid loss following burns, sequestration of fluid in soft tissue injuries and infections, diuretics, renal disease/ adrenal insufficiency.

II. Less obvious causes

Unsuspected inadequate fluid intake, fluid loss through excessive sweating as in high fever, hot humid temperature, haemodialysis, haemofiltration from surgical incisions and in diseases like tetanus.

Management

The first principle is to restore circulating volume through infusion of intravenous fluids. Once this is satisfactorily achieved, disturbances in electrolytes and acid-base balance, if present, need to be rectified. Various fluids used for volume replacement are given below.

A. Replacement fluids

1. Replacement fluids are used to replace abnormal loss of blood, plasma or other extracellular fluids as first line treatment for hypovolaemia in:
   a. Treatment of patients with established hypovolaemia, e.g. haemorrhagic shock.
   b. Maintenance of normovolaemia in patients with ongoing fluid losses, e.g. surgical blood loss.
2. Intravenous replacement fluids are the first line of treatment for hypovolaemia. Initial treatment with these fluids may be life-saving and provides some time to control bleeding and obtain blood for transfusion, if it becomes necessary.
3. Crystalloid maintenance fluids, which contain dextrose, are not suitable for use as replacement fluids. Only crystalloid solutions with a similar concentration of sodium to plasma (normal saline or balanced salt) solutions (Ringer's lactate or Hartmann's solutions) are effective as replacement fluids. These should be available in all hospitals where intravenous replacement fluids are used. Fluid and electrolyte requirements in adults and children are shown in Table 2.5.
4. Crystalloids should be infused in a volume at least three times the volume lost in order to correct hypovolaemia.
5. All colloid solutions (albumins, dextran, gelatins and hydroxyethyl starch solutions) are replacement fluids. However, they have not been shown to be superior to crystalloids in resuscitation.
6. Colloid solutions should be infused in a volume equal to the blood volume deficit.

7. Plasma should never be used as a replacement fluid.
8. Plain water should never be infused intravenously. It will cause haemolysis and will probably be fatal.
9. In addition to the intravenous route, the intraosseous, oral, rectal or subcutaneous routes can be used for the administration of fluids, blood and certain drugs. However, with the exception of intraosseous route, other routes are generally unsuitable in severely hypovolaemic patients.
10. Rectal fluids are administered through a plastic or rubber enema tube which is inserted into the rectum and connected to a bag or bottle of fluid. The fluid rate can be controlled by using a drip giving-set, if necessary. The fluids used need not be sterile. A safe and effective solution for a rectal rehydration is 1 liter of clean drinking water with teaspoon of table salt.
11. Subcutaneous fluids: Occasionally, when other routes of administration of fluids are unavailable, a subcutaneous infusion can be used. A cannula or needle is inserted into the subcutaneous tissue (the abdominal wall is a preferred site) and sterile fluids are administered in a conventional manner. Do not give dextrose-containing solutions subcutaneously as they can cause sloughing of tissues.
12. Oral and nasogastric fluids: Oral rehydration can often be used in mildly hypovolaemic patients, if the oral route is not contraindicated. Do not use, if:
    - The patient is unconscious.
    - The patient has gastrointestinal lesions or reduced gut motility e.g. obstruction.
    - General anaesthesia and surgery is planned imminently.

WHO/UNICEF formula for low osmolarity oral rehydration fluid:

Dissolve in one litre of drinkable water	
Sodium chloride	2.6 g/L
Trisodium citrate, dihydrate	2.9 g/L
Potassium chloride	1.5 g/L
Glucose anhydrous	13.5 g/L
Resulting concentrations	

Na^+ 75 mmol/L, Cl^- 65 mmol/L, K^+ 20 mmol/L, Glucose anhydrous 75 mmol/L, Citrate 10 mmol/L, Total osmolarity 245 mmol/L.

B. Maintenance fluids

Maintenance fluids are fluids used to replace the normal physiological loss that occurs in a patient through skin, lung, faeces and urine. Since a considerable proportion of the loss is water, maintenance fluids are mainly composed of water in the form of a dextrose solution. Some electrolytes may also be included in these solutions.

All maintenance solutions are crystalloid solutions. Some examples of crystalloids that are suitable as maintenance fluids are: 50% dextrose and 4% dextrose in sodium chloride 0.18%.

Table 2.5. Fluid and electrolyte requirements for adult and children under normal circumstances

Weight	Fluid ml/kg/24 h	Sodium mmol/kg/ 24 h	Potassium mmol/ kg/24 h
Children			
First 10 kg	100 (4*)	3	2
Second 10 kg	50 (2*)	1.5	1
Subsequent kg	20 (1*)	0.75	0.5
Adults			
All weights (kg)	35(1.5*)	1	0.75

*These figures represent the fluid requirements in ml/kg/hour.

Safety

Before giving any intravenous infusion:

1. Check that the seal of the infusion fluid bottle or bag is not broken.
2. Check the expiry date.
3. Check that the solution is clear and free from visible particles.

VOLUME EXCESS

Volume excess is often iatrogenic, when the fluid intake has consistently exceeded the output. Excessive intravenous infusions of saline, and blood transfusions are important causes of hypervolaemia. Renal insufficiency, congestive heart failure, liver disease and other causes of sodium retention, or excessive sodium administration can all produce increase in extracellular fluid content and hypervolaemia.

SALIENT FEATURES

- Oedema, ascites, pleural effusion, neck veins full, pulmonary congestion, hyperdynamic circulation with tachycardia, a warm skin, and a bounding pulse.
- Increase in the systolic pressure and pulse pressure.
- CVP >12 mmHg, pulmonary capillary wedge pressure (PCWP) >20 mmHg in the presence of pulmonary oedema.

Treatment

In cases of moderate volume excess, salt restriction, restriction of fluid intake and the use of frusemide as a diuretic. Fulminant pulmonary oedema secondary to overhydration from overtransfusion of blood or fluids is more appropriately dealt with by phlebotomy in stages so that PCWP is reduced below 15 mmHg. Rarely, ultrafiltration (dialysis) may be required.

References

1. Anaesthesia at the District Hospital. In: World Health Organization in collaboration with the World Federation of Societies of Anesthesiologists, Geneva, 2nd Edition, World Health Organization, 2000.
2. Life Threatening Electrolyte Abnormalities. Circulation 2005; 112: IV-121-I

Treatment

Treatment of common causes of stridor is discussed below in four sections:

A. Acute laryngitis/laryngotracheobronchitis
B. Spasmodic croup
C. Epiglottitis
D. Diphtheria

A. Acute laryngitis, laryngotracheobronchitis (croup)

It is an acute infection of the larynx and is usually caused by viruses. In children, may lead to respiratory obstruction.

Nonpharmacological

- Maintain airway by positioning the patient in lateral position with neck slightly extended.
- Gentle suction of secretions, if required.
- Oxygen by ventimask/hood at the rate of 4-6 L/min.
- With the supportive and specific therapy, need for endotracheal intubation/ tracheostomy may arise rarely. In case, the patient is deteriorating steadily despite therapy, elective intubation/tracheostomy should be done to prevent respiratory failure.

Pharmacological

Mild cases with minimal stridor (hoarse voice, barking or hacking cough, stridor heard on exertion/crying) do not require any treatment and may need home care with voice rest, feeding and fluids only with clear instructions on when to report immediately.

Moderate (stridor at rest) and severe cases (to be hospitalized immediately) need specific therapy in the form of:

1. Inj. Dexamethasone 0.6 mg/kg IM stat or oral Prednisolone 1-2 mg/kg
2. Inhaled Adrenaline 0.01 - 0.05 mg/kg/dose to be diluted in 3 ml saline every 1-2 hours. A few doses can be administered until side effects, viz. tachycardia, tremors, etc. appear.
   Or
   Inhaled Budesonide 500-1000 mcg/dose 12 hourly till response is seen.
3. Intravenous fluids maintenance dose (see respective section on fluids and electrolytes in adults and children).
4. Oxygen therapy

5. Intubation or tracheostomy in children with incipient obstruction (such as severe indrawing of the lower chest wall and restlessness).
   Antibiotics are not recommended.

B. Spasmodic croup

It occurs most commonly in children 1-3 years of age. It is possibly allergic and recurrent and occurs more often in the evening or night time. It has sudden onset, preceded by mild coryza and hoarseness. Symptoms usually diminish within few hours.

Taking out the child with spasmodic croup in fresh air may decrease the airway obstruction.

C. Epiglottitis

It is usually caused by *H. influenzae* and is a potentially life-threatening condition. Lateral X-ray of soft tissue neck may show swollen epiglottis (thumb sign). It is a medical emergency; airway and specific therapy must be introduced aggressively.

Treatment

1. Nonpharmacological treatment as above in acute laryngitis.
2. Inj. Cefotaxime 100 mg/kg/day divided into 3 doses.
   Or
   Inj. Ceftriaxone 100 mg/kg/day (maximum dose 4 g/day) in 2 divided doses.
   If cephalosporins not available Tab. Chloramphenicol 500 mg 6 hourly.
   In Children 100 mg/kg/day divided into 6 hourly doses.

D. Diphtheria

It is usually seen in non-immunized children.

SALIENT FEATURES

- Presents as stridor but laryngeal examination may show a membrane-like structure (pseudomembrane), removal of which leads to bleeding.
- Large cervical lymph nodes (bull neck appearance) and hoarseness.
- Common complications are palatal palsy, III nerve palsy, polyneuritis and myocarditis.

Treatment

1. Supportive treatment as above in acute laryngitis.
2. Immediately refer the child to infectious diseases hospital under supervision and oxygen therapy. In case the child cannot be transferred, isolation should be done and following measures should be taken immediately:
3. Inj. Diphtheria antitoxin 20,000 - 40,000 IU, IV or IM for pharyngeal and laryngeal involvements with disease present for < 48 hours; 40,000 to 60,000 IU for

nasopharyngeal infections; 80,000 to 100,000 IU for diffuse involvement that has been present for > 3 days.

4. Inj. Crystalline penicillin 1 Lac - 1.5 Lac units/kg/day divided into 4 doses for 14 days.
   Or
   Inj. Procaine penicillin 25,000 - 50,000 units/kg/day in 2 divided doses for 14 days.
   Or
   Syr. Erythromycin 40-50 mg/kg/day divided into 4 doses for 14 days.
5. IV saline infusion over 60 min.
6. Rifampicin, clindamycin can be used in patients allergic to penicillin.

Monitoring and follow-up

1. Watch the child for altered sensorium, degree of stridor, pulse rate, respiratory rate and for other features of respiratory distress like intercostal recession, etc.
2. Laryngeal examination should not be done until facilities for intubation are available because it might lead to sudden respiratory arrest.
3. If child develops stridor at rest, hospitalize immediately.
4. Increasing respiratory distress with alteration of sensorium or cyanosis may be an indication for intubation.

Patient education

- Avoid overuse and misuse of voice.
- If stridor worsens or is noticed at rest, the patient should immediately report to the nearest health facility.
- Children with diphtheria should be completely immunized after recovery of the current episode and contact to be immunized immediately (See section on immunization in Chapter 19).

References

1. Stridor. In: Scott Brown's Otolaryngology: 7th Edition, Volume 5, 2008; pp. 1114-1126.
2. Congenital Anomalies of the Larynx. In: Nelson's Textbook of Paediatrics. Behrman RE, Kleigman RM, Jenson HB (eds). 19th Edition, 2011; pp 1450-1452.

SEPTICAEMIA

Sepsis is a commonly encountered problem and a major cause of mortality in 80% of children. Septicaemia is a clinical condition associated with invasion of bloodstream by microorganisms giving rise to features of systemic inflammatory response syndrome (SIRS), i.e. presence of any two of the following: fever/hypothermia, tachypnoea, tachycardia, leucocytosis/leucopenia. It may be associated with infection at specific sites (e.g. lungs, urinary tract, gastrointestinal tract) or there may be no clear originating focus. Septicaemia occurs more commonly in patients with defective body defenses. In previously healthy persons, *Staphylococcus aureus*, *Streptococcus pneumoniae* and *Escherichia coli* are the most frequent organisms, while in patients with defective immune

systems, Gram-negative bacteria including *Pseudomonas aeruginosa* may be responsible. Other febrile illnesses due to enteric fever and malaria may be difficult to differentiate from these pathogens clinically. Septicaemia, when persists, can result in multiorgan dysfunction syndrome requiring immediate intervention to maintain haemostasis.

SALIENT FEATURES

- Definitions of sepsis
  - *A. Systemic inflammatory response syndrome* (SIRS): The presence of at least two of the following four criteria, one of which must be abnormal temperature or leucocyte count:
    1. Core [oral or rectal] temperature of >38.5°C or <36°C
    2. Tachycardia, in the absence of external stimulus, chronic drugs, or painful stimuli; or otherwise unexplained persistent elevation over a 0.5 h time period or for children <1 year old: bradycardia, in absence of external vagal stimulus, β-blocker drugs, or congenital heart disease; or persistent depression over a 0.5-h time period.
    3. Tachypnoea for an acute process not related to underlying neuromuscular disease.
    4. Leucocyte count elevated or depressed for age [not secondary to chemotherapy-induced leucopenia] or >10% immature neutrophils.
  - *B. Infection*: A suspected or proven infection caused by any pathogen or a clinical syndrome associated with a high probability of infection. Evidence of infection includes positive findings on clinical examination, imaging, or laboratory tests (e.g. leucocytes in a normally sterile body fluid, perforated viscus, chest radiograph consistent with pneumonia, petechial or purpuric rash, or purpura fulminans) or a positive culture, tissue stain, or polymerase chain reaction test.
  - *C. Sepsis*: SIRS in the presence of or as a result of suspected or proven infection.
  - *D. Severe sepsis*: Sepsis plus one of the following: Cardiovascular organ dysfunction OR acute respiratory distress syndrome or two or more other organ dysfunctions.
  - *E. Septic shock*: In a child with sepsis presence of: Hypotension [systolic BP <70 mmHg in infant; <70 + 2 × age after 1 year of age] or need for vasoactive drug to maintain BP above fifth centile range [dopamine >5 mcg/kg/min or dobutamine, epinephrine, or norepinephrine at any dose] or Signs of hypoperfusion—any three of the following: Decreased pulse volume [weak or absent dorsalis pedis pulse], capillary refilling time >3 s, tachycardia, core [rectal/oral] to peripheral [Skin-toe] temperature gap >3°C, and urine output <1 ml/kg/h [<20 ml/h in >20 kg child] or sepsis and cardiovascular organ dysfunction.
  - *F. Multiple organ dysfunction*: The detection of altered organ functions in the acutely ill patient constitutes multiple organ dysfunction syndrome (MODS; two or more organs involvement).

Treatment

Nonpharmacological

1. Care of airway and breathing as given in section on CPR.
2. After initial assessment, a central venous catheter (CVC) should be inserted in most patients with severe sepsis or septic shock.
3. If hypoperfusion exists, early restoration of perfusion to prevent or limit multiple organ dysfunction, as well as reduce mortality.
4. Removal or drainage of a focal source of infection. Indwelling intravenous catheter, Foley's catheter, etc. should be replaced, if considered as a source.
5. General care of skin, orodental hygiene and nutrition supplementation should be taken care of, in prolonged severe sepsis.

Pharmacological

1. Oxygen therapy—2-4 liters/min with catheter/mask (to keep SPO_2 >95%).
2. Intravenous fluids—to be guided by haemodynamic status. If in shock, aggressive fluid therapy and drugs as mentioned in section on shock to maintain urinary output at more than 1 ml/kg/hour.
3. Antimicrobial agents—antimicrobial therapy should be initiated as soon as samples for culture are withdrawn from blood and other relevant sites. Choice of antibiotics depends on suspected organism.

Immunocompetent host

1. Inj. Cefotaxime 150-200 mg/kg/day in 3 divided doses.

   Or

   Inj. Ceftriaxone 100 mg/kg/day (maximum dose 4 g/day) in 2 divided doses.
2. Inj. Gentamicin 7.5 mg/kg/day in 2-3 divided doses.

   Or

   Inj. Amikacin 15 mg/kg/day in 2-3 divided doses.
3. Add Penicillin/Vancomycin, if *Streptococcus*/*Staphylococcus* organisms are suspected

   Inj. Penicillin G aqueous 200,000-300,000 units/kg IV 4 hourly.

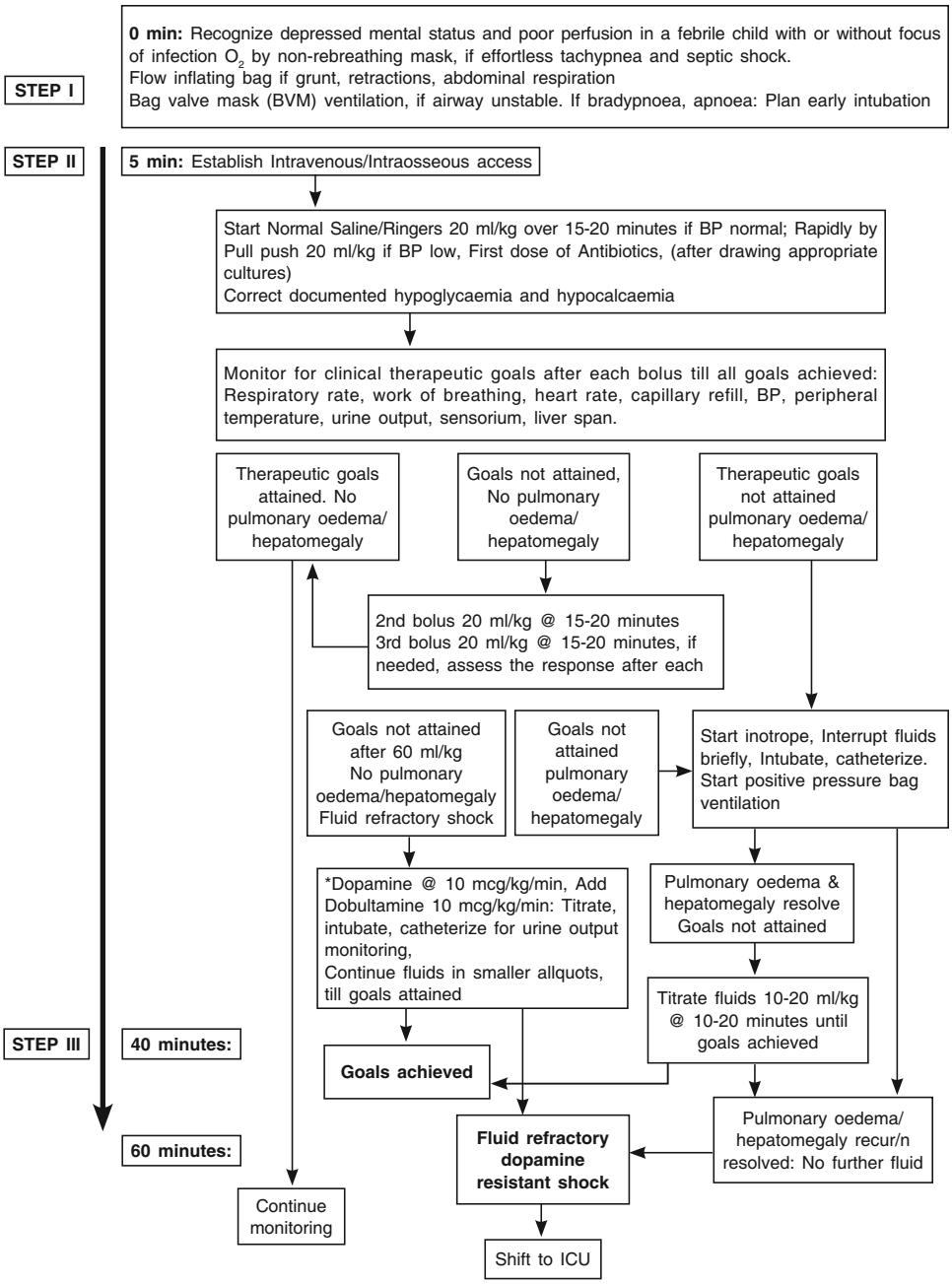
   Or

   Inj. Vancomycin 15 mg/kg/day in 2 divided doses.

Immunocompromised host

1. Inj. Ceftazidime IV 150 mg/kg/day in 3 divided doses.
2. Inj. Vancomycin 15 mg/kg/day in 2 divided doses.

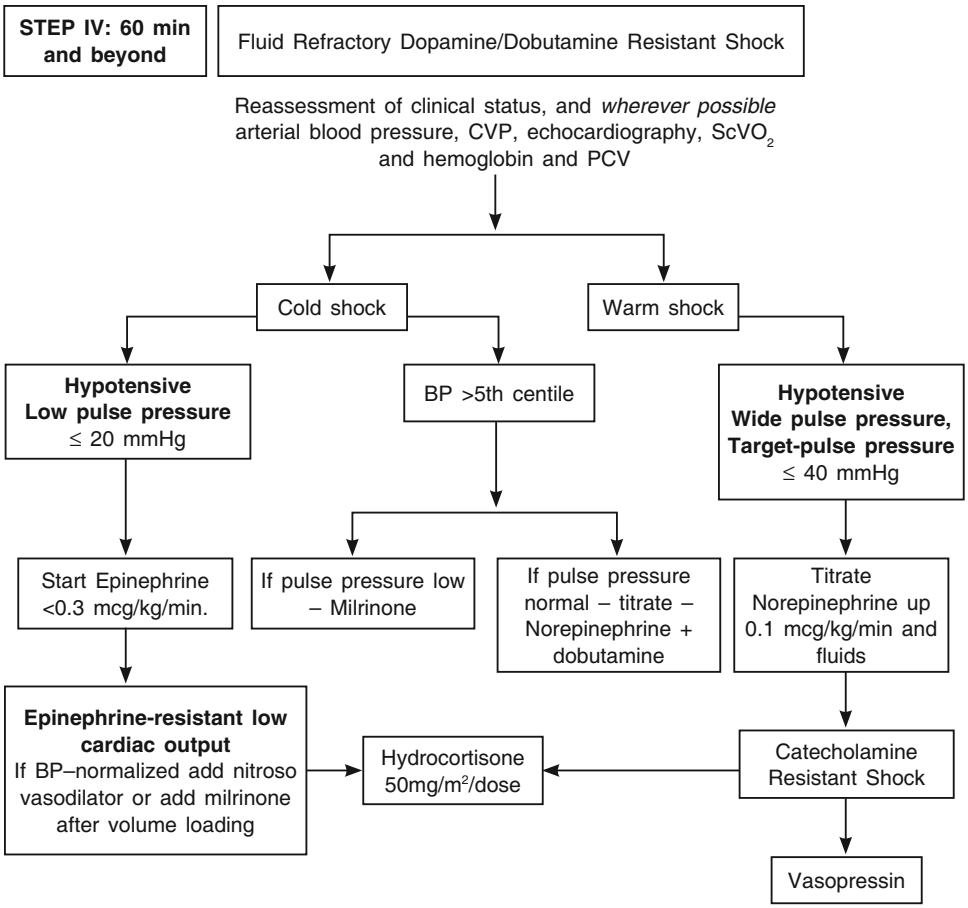
Treatment algorithm for management of severe sepsis and shock in children (Fig. 2.8).



* Dopamine may be started after 2nd bolus

Plan epinephrine infusion early, if bradycardia, BP remains low or falls with cold shock at any step. Relief of temponade, such as pneumothorax, or pericardial tamponade, increased intra-abdominal pressure due to fluid should be considered at any point.

Fig. 2.8. (Continued)



PCV: packed cell volume, CVP: central venous pressure, $ScVO_2$: Mixed venous O_2 saturation
Maximum dose of both Norepinephrine and Epinephrine is 1 mcg/kg/min

Fig. 2.8. Treatment algorithm for management of severe sepsis and shock in children.

Follow-up and monitoring

- Continuous monitoring of pulse, respiratory rate, blood pressure, capillary filling time, urinary output and neurological status should be done for early detection of septic shock or multiorgan failure. Patient should be referred to tertiary level centre, if very sick or shows no signs of improvement after initial therapy.

Therapeutic endpoints of resuscitation of septic shock in children:

1. Normalization of the heart rate
2. Capillary refill of <2 sec

3. Well-felt dorsalis pedis pulses with no differential between peripheral and central pulses
4. Warm extremities
5. Normal range of systolic pressure and pulse pressure
6. Urine output >1ml/kg/hour
7. Return to baseline mental status tone and posture
8. Normal range respiratory rate

Other endpoints that have been widely used in adults and may logically apply to children include central venous pressure of 8–12 mmHg. Resuscitation of the circulation should target a central or mixed venous oxyhaemoglobin saturation ($ScvO_2$ or SvO_2, respectively) of ≥70%. Other common goals include a central venous pressure (CVP) 8 to 12 mmHg, a mean arterial pressure (MAP) ≥65 mmHg, and a urine output ≥0.5 mL/kg per hour.

Patient/parent education

Immunocompromised patients should be informed about features of early sepsis. Fever in any child with congenital or acquired immunodeficiency state should be taken very seriously.

References

1. Severe Sepsis and Septic Shock. In: Harrison's Principles of Internal Medicine. Fauci, Braunwald, Kasper et al (eds), 18th Edition, McGraw Hill Company Inc., New York, 2012; pp. 2223-2232.
2. Shock. In: Nelson's Textbook of Paediatrics. Behrman RE, Kleigman RM, Jenson HB (eds), 19th Edition, WB Saunders, 2011; pp. 305-314.
3. Praveen Khilnani, Sunit Singhi, Rakesh Lodha, et al, Pediatric Sepsis Guidelines: Summary for resource-limited countries. Indian J Crit Care Med. 2010; 14: 41–52.
4. Facility Based IMNCI (F-IMNCI) Participants Manual. WHO, UNICEF, and Ministry of Health & Family Welfare, Government of India, 2009.

HEAD INJURY

Head injuries are frequent form of injuries in cities. A systematic approach is required to differentiate trivial injury from severe forms which may be life-threatening or may lead to neurological sequelae.

Treatment

- The management of head injured patients should be guided by clinical assessments and protocols based on the Glasgow Coma Scale and Score (GCS) (see below in section on Coma).
- Symptoms and signs of severe forms may appear immediately as in concussions or contusions or may appear after a few minutes to hours as in acute subdural haematoma. Patients admitted for a head injury may be discharged after resolution of all significant symptoms and signs provided they have suitable supervision arrangement at home and are able to access to hospital with written and verbal instructions to report back in case of deterioration.

- Patients with history of unconsciousness at any time since injury, amnesia for the incident or subsequent events, severe and persistent headache, nausea, vomiting, bleeding from nose/ear, seizures or presence of black eye, suspected fracture of skull and haematoma of scalp indicate severe form of head injury and require hospitalization.

Minor injury (GCS 13-15)

A patient who is alert and has only one or more symptoms of headache, faintness, nausea, a single vomiting, difficulty with concentration or slight blurring of vision, may have scalp bruising or laceration should be kept under observation for a few hours and then sent home with proper instructions to the family members. Decision for X-ray skull and CT scan depends on degree of trauma to the rest of body and skull, in addition to the worsening of symptoms and signs.

Moderate head injury (GCS 9-12)

Patients with brief loss of consciousness at time of injury but currently alert or responds to voice, may be drowsy, have two or more episodes of vomiting, persistent headache, up to one single brief (<2 min) convulsion occurring immediately after the impact, may have a large scalp bruise, haematoma or laceration but normal examination otherwise. If, on the history from the parents and ambulance, the child is not neurologically deteriorating, he/she may be observed in the Emergency Department for a period of 4 hours with 30 minutely neurological observations (conscious state, PR, RR, BP, pupils and limb power).

The patient may be discharged, if there is improvement at 4 hours to normal conscious state and no further vomiting (patient should be able to tolerate oral fluids in the hospital) and with full written and verbal instructions to caregiver on when to report back immediately as given in the patient education section.

A persistent headache, large haematoma or possible penetrating wound may need further investigation, discuss with consultant. If the patient is still drowsy or vomiting at 4 hours or there is any deterioration during this time, consult with a neurosurgeon regarding admission and further investigation.

Severe head injury (GCS 8 or less)

Patients with persistent confusion, behavioural change, coma, focal neurological signs and features of raised intracranial pressure require immediate attention and should be admitted to the hospital. A CT scan should be done in all such cases and treated as follows:

1. Check and maintain airway and breathing (see section on Cardiopulmonary Resuscitation).
2. Check circulation by pulse volume, rate, blood pressure.
3. Establish IV access.
4. IV fluids according to volume loss (see section on Shock).

5. Check for and stabilize extracranial injuries.
6. A head injury may be accompanied by a cervical injury. If spinal injuries are excluded, then transfer the patient in side position with head down, to a tertiary care centre where neurosurgical interventions are available.
7. If spinal injury is suspected then transfer the patient on a hard board, place two sand bags on either side of the head.
8. Assessment by Glasgow Coma Scale (as given in a section on Coma) may be used to prognosticate or follow a patient of head injury for improvement/deterioration of neurological status. Patients with Glasgow Coma Scale score 8 or less or with deterioration of level of consciousness should be transferred to a centre where facilities for neurosurgical interventions are available. Over 85% of patients with aggregate score of 3 or 4 die within 24 hours while score of 11 or more indicates death in only 5-10%.
9. A subdural haematoma, epidural haematoma or large intracerebral haematoma may require surgical intervention and must immediately be attended to by a neurosurgeon.
10. Hyperthermia, hypoxia and hypercarbia exacerbate intracranial pressure, so does an awkward head position like acute flexion. These conditions must be appropriately treated, if necessary by mechanical ventilation.
11. Increased intracranial pressure can be treated with Inj. Mannitol (20%) 0.25 - 1 g every 3 to 4 hours.

Patients with a head injury, who warrant admission, should have neurological observations carried out at least in the following frequency starting after initial assessment in the emergency department:

- Half hourly for 2 hours
- Hourly for 4 hours
- Two hourly for 6 hours
- Four hourly thereafter until agreed to be no longer necessary.

Patient education

- Patients admitted with mild head injury benefit from brief, routine follow up consisting of advice, education and reassurance that they are likely to recover. Apply ice or a cool wash to the area injured to help reduce the swelling. If a patient has been sent home considering the initial diagnosis of minor head injury, the family members must be advised to report back in case of persistent/increasing headache, vomiting, and deterioration of level of consciousness or appearance of any focal motor weakness.
- A guarded prognosis in severe head injury is given but some children and young adults show remarkable recoveries despite low score on Glasgow Coma Scale.
- Problems to watch for in the next day or two: **Headache**. Patient may have a headache. Give paracetamol every 4-6 hours, if needed to relieve pain or the pain does not go away, with a instruction to report back to doctor.

- **Vomiting.** Patient may have vomited once but if vomiting continues, report back to the doctor.
- **Drowsiness.** Immediately after the head injury patients may be sleepy. There is no need to keep the patients awake, if they want to sleep. If patients do go to sleep, wake them every half to one hour to check their condition, and their reaction to familiar things. One should do this until they are no longer drowsy and have been awake and alert for a few hours.
- Some questions one could ask are: Do they know where they are? Do they know familiar people's names? Do they know which day it is? Or if they are very young: Do their reactions seem appropriate? i.e., reaching out for a dummy. Are they interactive and not too irritable?
- If there is any difficulty waking your child, report to the nearest emergency department or call an ambulance. If patients, behaviour is very different to their normal behaviour.
- Patients with a more severe head injury admitted for up to 72 hours should be assessed for intensive rehabilitation.

References

1. Concussion and Other Head Injury. In: Harrison's Principles of Internal Medicine. Fauci, Braunwald, Kasper et al (eds), 18th Edition, McGraw Hill Company Inc., New York, 2012; pp. 3377-3382.
2. Early management of patients with a Head Injury. Scottish Intercollegiate Guidelines Network (SIGN) 2009.
3. Head Injury (G 56) National Institute for Health and Clinical Excellence (NHS) Nice Guideline 2007.

COMA

Coma is defined as a prolonged period of unconsciousness and lack of reaction to stimulus. Patients in coma cannot be aroused.

SALIENT FEATURES

Following causes affect the functions of reticular-activating system and its connections with cerebrum.

- Structural damage to brain (haemorrhage, tumours, trauma, localized infections, meningitis, stroke).
- Metabolic disturbances (ischaemia, anoxia, uraemia, diabetes), respiratory/hepatic/renal failure, dyselectrolytaemia, endocrinopathies, drugs like opiates, barbiturates, benzodiazepines, antidepressants and cyanide.
- Abnormal electrical activity—periodic lateralized epileptiform discharge (PLED).

Treatment

Nonpharmacological

- The immediate goal in acute coma is the prevention of further nervous system damage.
- Hypotension, hypoglycaemia, hypercalaemia, hypoxia, hypercapnia, and hyperthermia should be corrected rapidly and assiduously.
- An oropharyngeal airway is adequate to keep the pharynx open in drowsy patients who are breathing normally.
- Tracheal intubation is indicated, if there is apnoea, upper airway obstruction, hypoventilation or emesis, or if the patient is liable to aspirate because of coma.
- Mechanical ventilation is required, if there is hypoventilation or if there is an intracranial mass and a need to induce hypocapnia in order to lower intracranial pressure.
- Establish intravenous access and draw blood sample for biochemical and other investigations.

Pharmacological

1. Inj. Glucose (25 or 50%) 50 g IV.
2. Inj. Thiamine 100 mg IV.
3. If opiate overdose is suspected, give Inj. Naloxone 0.8 mg IV. If response is inadequate, double the dose every 15 minutes (for details see section on Opioid Intoxication).
4. If benzodiazepine overdose is suspected, give Inj. Flumazenil 200 mcg IV slowly. If no response repeat 100-200 mcg after 1 minute. If required, give maximum dose of 1 mg or give as IV infusion of 100-400 mcg/h, if drowsiness recurs.
5. If focal neurological deficit or signs of herniation/decerebration/decortication occurs, CT scan, EEG and neurologic consultation are required.
6. If no clear aetiology and no herniation—CSF examination should be done.
7. If signs of raised intracranial tension (papilloedema, convulsions, decerebrate posture indicating herniation) occurs:
   a. Avoid giving free fluid (glucose solution) intravenously.
   b. Inj. Frusemide 40 mg IV to maintain adequate urine output of 30-50 ml/h.
   c. Inj. Mannitol 1.0 g/kg IV over 10 minutes.
   d. Hyperventilate to bring down PCO_2 to 25 mmHg.
   e. Inj. Dexamethasone 20 mg IV stat and 6 mg 4 hourly.

Children and young adults may have ominous early clinical findings such as abnormal brainstem reflexes and yet recover. Metabolic comas have a far better prognosis than traumatic comas. Glasgow Coma Scale empirically has predictive value in case of brain trauma (Table 2.6 & 2.7). Children who have sustained a head injury should be referred to hospital, if any of the following risk factors applies: Clinical suspicion of non-accidental injury; significant medical comorbidity (e.g. learning

difficulties, autism, metabolic disorders); difficulty making a full assessment; not accompanied by a responsible adult or social circumstances considered unsuitable.

For anoxic and metabolic coma, clinical signs such as pupil size reactivity and motor responses after 1 day, 3 days and 1 week have been shown to have predictive value. Absence of cortical waves of the somatosensory evoked potentials has also proved a strong indicator of poor outcome in coma from any cause.

Grading of coma

Table 2.6. Glasgow Coma Scale in adults

Eye opening (E)	**Coma score**
Spontaneous	4
To loud voice	3
To pain	2
Nil	1
Best motor response (M)	
Obeys command	6
Localizes pain	5
Withdraws (flexion)	4
Abnormal flexion posturing	3
Extension posturing	2
None	1
Verbal response (V)	
Oriented	5
Confused, disoriented	4
Inappropriate words	3
Incomprehensible sounds	2
None	1
Total Coma Score	**3/15—15/15**

Note: Coma score=E+M+V. Patients scoring 3 or 4 have an 85% chance of dying or remaining vegetative, while scores above 11 indicate only a 5 to 10% likelihood of death or vegetative state and 85% chance of moderate disability or good recovery. Intermediate scores correlate with proportional chances of recovery.

Table 2.7. Glasgow Coma Scale in children under 5 years of age

Feature	**Scale**	**Score**
	Responses	**Notation**
Eye opening	Spontaneous	4
	To voice	3
	To pain	2
	None	1

Feature	Scale	Score
	Responses	**Notation**
Verbal response	Orientated/interacts/follows objects/smiles/alert/coos/ babbles words to usual ability	5
	Confused/consolable	4
	Inappropriate words/moaning	3
	Incomprehensible sounds/irritable/inconsolable	2
	None	1
Best motor response	Obey commands/normal movement	6
	Localise pain/withdraw to touch	5
	Withdraw to pain	4
	Flexion to pain	3
	Extension to pain	2
	None	1
TOTAL COMA 'SCORE'		3/15–15/15

Great care should be taken when interpreting the Glasgow Coma Scale in the under fives and this should be done by those with experience in the management of the young child.

References

1. Coma. In: Harrison's Principles of Internal Medicine. Fauci, Braunwald, Kasper et al (eds), 18th Edition, McGraw Hill Company Inc., New York, 2012; pp 2247-2253.
2. Concussion and Other Head Injury. In: Harrison's Principles of Internal Medicine. Fauci, Braunwald, Kasper et al (eds), 18th Edition, McGraw Hill Company Inc., New York, 2012; pp 3377-3382.
3. Early management of patients with a Head Injury. Scottish Intercollegiate Guidelines Network (SIGN) 2009.

POISONING

General considerations

Increasing incidence of poisoning is attributable to rapid development of newer compounds in trade, industry and medicine and easy access to them. A stepwise care approach to a patient of poisoning is helpful in successful management.

Stepwise care approach

- Diagnosis—suspect and identify poison, if possible.
- Treatment includes basic principles, antidotes, symptomatic and supportive.
- Anticipate complications, preserve evidence and prevent sequelae as well as recurrence.

Diagnosis

1. Suspicion of poisoning should be aroused by sudden onset of symptoms, uniform and increasing severity of symptoms in a group, e.g. food poisoning or industrial poisoning. Unexplained nausea, vomiting, diarrhoea, drowsiness or coma, euphoria, increased psychomotor activity, convulsions, delirium and unusual breath smell are symptoms which in the absence of disease need careful evaluation for suspected poisoning. Signs and symptoms helpful in diagnosis of poisoning are shown in Table 2.8.
2. Identification of the substance should not take precedence over the first step, since the process is slow and unreliable and further lack of proper history might add to confusion. Action of poisons is modified by physical factors like quantity, form, chemical combination, dilution, route of administration and host factors like age, idiosyncrasy, sleep, food and use (abuse) of multiple substances.

Table 2.8. Signs and symptoms helpful in diagnosis of poisoning

Signs	Poisons
1. CNS signs	
Delirium/ hallucinations	Antihistamines, dhatura, atropine and related drugs, psychomimetics, bromides, salicylates, pesticides.
Depression/coma	Barbiturates and other sedatives, hypnotics, tranquilizer, morphine group, organic solvents, carbon monoxide, cyanides.
Convulsions	Organophosphates, organochlorines, phenol, amphetamine, atropine, kerosene, aminophylline, benzoyl benzoate, salicylates, strychnine.
Weakness or paralysis	Lead, arsenic, botulism, organic mercurials, triorthocresyl phosphate, pesticides.
Fasciculations	Organophosphates.
Dilated pupil	Atropine group, cocaine, nicotine.
Small pupil	Opium group, phenothiazines, organophosphates.
2. Respiratory signs	
Respiratory difficulty	Organophosphate-insecticides, salicylates, botulism, carbon monoxide, cyanides, atropine.
Cyanosis without respiratory distress	Methaemoglobinaemia.
3. Temperature abnormality	
High fever	Salicylates, anticholinergic, atropine, organophosphates, nitrophenols, kerosene, paracetamol.
Hypothermia	Opiates, barbiturates.
4. CVS signs	
Hypotension	Beta-blockers, sedatives, hypnotics or narcotic.
Hypertension	Amphetamine or sympathomimetic overdose, sedative or narcotic withdrawal.
Bradycardia	Digitalis, beta-blockers, calcium channel antagonists or hypothermia.
5. Odours	Kerosene, bitter almond-cyanides, garlic-parathion, organophosphates, phosphorus, alcohol, paraldehyde, phenols and cresols, sulfides.

Treatment

Poisoned patients may deteriorate rapidly. Care for all adult patients who are critically ill or under evaluation for possible toxin exposure or ingestion, particularly when the history is uncertain, should begin in a monitored treatment area where the development of central nervous system depression, haemodynamic instability, or seizures can be rapidly recognized and addressed.

A. Basic principles and first aid measures

- Attention to ABC of resuscitation is utmost priority at all times.
- Removal of poison from the person or person from the poison.
- Removal of contaminated clothing. In case of skin contamination with toxic materials, a shower or drenching the skin in a water tub and use of soap and water will mechanically remove the substance.
- For eye contamination, washing the eye with running clean water, holding the lids apart is a useful measure. Rubbing of eyes is to be discouraged. Use of sterile liquid paraffin will prevent irritation.
- When a toxic substance has been inhaled, removal of the person away to open surroundings, loosening of clothes and if necessary, artificial respiration are important first aid measures.

In case of venomization by snake or other insect bites (see section on Snake Bite), washing the area with clean water will mechanically remove the venom. **Suction (oral) of the bite area should be discouraged**. If the patient is unconscious, put the patient in a position lying on one side (preferably left side) with head tilted slightly backwards so that choking due to falling back of the tongue is prevented.

B. Removal of ingested poison

Gastrointestinal decontamination, once a mainstay in the management of ingested toxins, has a less significant role in poisoning treatment today. With rare exceptions, gastric lavage, whole bowel irrigation, and administration of syrup of ipecac are no longer recommended.

Administer single-dose activated charcoal to adsorb ingested toxins in case of ingestion of life-threatening poisons for which no adequate antidotal therapy is available and when the charcoal can be administered within 1 hour of poisoning. Multiple-dose activated charcoal given in patients who have ingested a life-threatening amount of specific toxins (e.g., carbamazepine, dapsone, phenobarbital, quinine, or theophylline, tricyclic antidepressants, phenothiazines, alcohol, salicylates and many plant toxins). ***Charcoal should not be administered for ingestions of caustic substances, metals, or hydrocarbons***. Charcoal should only be administered to patients with an intact or protected airway. In patients who are at risk for aspiration, endotracheal intubation and head-of-bed elevation should be performed before charcoal administration. Because the decision to perform gastrointestinal decontamination is complex, multifactorial, and associated with risk, seek expert advice.

1. Induce emesis

   (**Caution**: Contraindicated in cases of corrosive poisoning, unconscious patients and in those who have swallowed petroleum products.)

   Mechanical tickling of the throat with fingers, spatula or tongue depressor will induce vomiting.

   Or

   Two to four teaspoonful (10-20 ml) of syrup ipecac followed by half a glass of water.

   (**Caution**: Contraindicated in children with age less than 6 months)

   Or

   Inj. Apomorphine hydrochloride 6 mg subcutaneously causes vomiting in 3-4 minutes but should be used with caution since it is also a depressant.

Elimination through other measures. Elimination of poisonous substances can be enhanced by use of diuretics like frusemide, ethacrynic acid, acetazolamide, and osmotic substances like urea and mannitol. Forced alkaline diuresis treatment is done in patients of barbiturate intoxication. Other effective measures to eliminate ionizable substances are peritoneal dialysis, haemodialysis and exchange transfusions.

C. Antidotes

The absorption of the ingested poison can be reduced by activated charcoal, cholestyramine, Fuller's earth, bentonite, etc. Commonly available specific antidotes are shown in Table 2.9.

Table 2.9. Commonly available specific antidotes

Poison	Antidote and dose
Carbon monoxide	Pure oxygen
Cyanide	Sodium nitrite 3% soln, 0.2 ml/kg, IV over 2 min followed by sodium thiosulphate (25% soln, 1 ml/kg, IV over 10-20 minutes)
Nitrate and nitrites	If methaemoglobinaemia, treat with methylene blue
Organophosphates	Inj. Atropine - 0.05 mg/kg, IV every 10 min until signs of atropinism Inj. PAM 25-50 mg/kg, IV in older children, and 250 mg IV in infants over 5-10 minutes, 8 hourly up to 36 hours; adults 1g IV repeated every 3-4 hours as needed, preferably as a constant infusion of 250-400 mg/kg
Anticholinergics	Inj. Physostigmine 0.56 mg slow IV over 5 min (atropine gp); repeated every 10 min till a maximum of 2 mg.
Narcotics (opium)	Inj. Naloxone - 0.1 mg/kg, IV or intratracheal, from birth up to 5 years or 20 kg of weight, at time a minimum of 2 mg should be used
Methyl alcohol	Ethyl alcohol

Poison	Antidote and dose
Phenothiazine	Inj. Diphenhydramine 1-2 mg/kg
Iron	Inj. Desferrioxamine 15 mg/kg/h IV in 100-200 ml 5% glucose soln (maximum 80 mg/kg in 24 hours; 100 mg of desferrixamine binds 8.5 mg of Iron).
Paracetamol	N-acetyl cysteine: Oral - initially 140 mg/kg, then 4 hourly up to 72 hours. IV 150 mg/kg by infusion over 125 min followed by 50 mg/kg 4 hourly for 72 hours.
Diazepam	Inj. Flumazenil in adults Initial dose: 0.2 mg IV one time over 30 seconds; 0.5 mg may be given every minute (most patients respond to 1 to 3 mg; Max total dose 3 mg). Patients responding partially at 3 mg may receive additional doses up to 5 mg. Resedation doses: 0.5 mg every 20 minutes to a total of 1 mg/dose and 3 mg/hour. *Children 1 to 17 years*: Initial dose: 0.01 mg/kg IV over 15 seconds. Repeat doses: 0.01 mg/kg given over 15 seconds; may repeat 0.01 mg/kg after 45 seconds, then every minute to a maximum total cumulative dose of 0.05 mg/kg.

D. Asymptomatic therapy

Give symptomatic therapy for pain, vomiting, diarrhoea, abdominal distension, convulsions, hyperexcitability and delusions (for details see respective sections).

E. Supportive treatment

Fluid and electrolyte disturbances are managed with proper laboratory investigations and assessment of intake and output. Careful monitoring of vital signs like temperature, pulse, respiration and blood pressure is mandatory. Metabolic needs are increased by about 10% with rise in temperature by 0.8ºC. Hypothermia delays detoxification and excretion of poison due to reduced metabolism and circulatory disturbances.

A comatose patient needs careful supervision for clear airway, proper oxygenation, prevention of aspiration of gastric contents by proper positioning, frequent change of position, care of bladder, bowels, skin, eyes and buccal mucosa. Antibiotics for infections are given according to the needs.

F. Other aspects

1. Complications of various types arise commonly in poisonings.
   Anticipating such complications and proper management help in successful outcome (Table 2.10).
2. Preserving evidence for medicolegal purposes and toxicological studies is the responsibility of the attending physician. Urine, stool, gastric contents (vomited or aspirated), blood and food samples and viscera should be preserved.
3. Prevention of sequelae like strictures following corrosive poisoning is done by using corticosteroids. Corticosteroids are useful in petroleum product poisoning to treat shock, lung syndrome and to prevent pulmonary fibrosis.

4. Preventing recurrence of poisoning is by proper labelling, keeping such substances away from children; keeping medicines, cosmetics and household products separately, and psychiatric consultation to patients who have taken drugs with suicidal intention.

Table 2.10. Complications in poisoning and their management

Complications	Poisons	Management
Pulmonary oedema	CNS depressants	Semirecumbent position,
	Organophosphorus	Diuretics
	compounds	Mannitol,
	Poisonous bites	Corticosteroids
Cardiac failure	Electrolyte disturbances	Cardiac glycosides
	Toxic myocarditis	
	Scorpion bites	
Cerebral oedema	Methyl alcohol	Diuretics
	Convulsions	Mannitol
		Dexamethasone
Acute renal failure	Nephrotoxic drugs	Management of shock
	Venoms	Alkaline urine
	Hypovolaemic shock	Fluid and electrolyte balance
	Haemolytic reactions	maintenance, dialysis
Acute hepatic failure	Poisonous substances	Management of liver failure
	Snake bites	

ORGANOPHOSPHORUS POISONING (OP)

Common agents for organophosphorus poisoning are malathion, parathion (fatal dose 0.1 mg/kg). Onset of symptoms is within 12 hours of exposure; usually following a household spraying.

SALIENT FEATURES

- Dizziness, headache, blurred vision, miosis, excessive lacrimation and salivation, nausea, vomiting, diarrhoea, epigastric pain, sense of constriction around chest, dyspnoea, sweating, muscle twitching and fasciculations, convulsions, flaccidity and muscle weakness, loss of reflexes and coma. Fasciculations are less common in children than adults. Bradycardia may occur in some children.
- A high index of suspicion is needed as the history of exposure may be denied. It may be confirmed by measuring red cell cholinesterase level, which is reduced to 20% of the normal values in clinically apparent poisoning (normal range 5-12 U/ml).

Treatment

Mild poisoning (normal consciousness, mild secretions and few fasciculations) suggests eventless recovery. Severe poisoning (copious secretions, generalized fasciculations, and altered consciousness) indicates the likelihood of complications and the need for ventilation. Life-threatening poisoning, generally associated with suicide attempts is characterized by a pO_2 <75 mmHg and abnormal chest X-ray. These patients need immediate ventilatory support.

1. Establish airway, suctioning, and oxygen. This is most urgent as death can occur from respiratory failure. Establish an IV line, monitor BP, and do not rush fluids.
2. Decontamination of the skin, mucous membrane and gut (if skin is contaminated, clean with soap water and change the clothing; gastric lavage and catharsis, if poison has been ingested).
3. Inj. Atropine IV 0.05 mg/kg every 10 minutes until signs of atropinism appear; maintain it for 24 hours. The signs of atropinism are: Drying of all secretions (most reliable), delirium, restlessness, fever, tachycardia, dryness of tongue and dilated pupils. As much as 10 times of usual dose of atropine may be required. (**Caution:** There is no fixed dose of atropine in OP poisoning. (The aim is to keep patient atropinised till poison effect weans off).
4. In severe cases, immediately give Inj. Pralidoxime (PAM) 25-50 mg/kg IV; in older children and in infants 250 mg IV over 5-10 minutes; and then 8 hourly up to 36 hours.
5. Assisted ventilation may be required in up to 25% of patients.

HYDROCARBONS (KEROSENE, PETROL)

This is the most common accidental poisoning in children, usually in infants and toddlers. Significant toxicity does arise from the inhalation of vapours or pulmonary aspiration of the liquid. Large amounts (100 ml or more) must be swallowed to allow GI absorption to produce pulmonary lesion.

SALIENT FEATURES

- Two major systems affected by hydrocarbon ingestion are the respiratory and central nervous systems.
- Respiratory symptoms are usually due to chemical pneumonitis or bronchopneumonia (cough, breathlessness, tachypnoea and fever) and may appear as early as within 15 minutes and as late as 24 hours after kerosene ingestion. Hyperexpansion of chest is seen occasionally. In severe cases, haemoptysis ensues. Cyanosis is accentuated and death may follow, usually within 24 hours.
- CNS involvement can cause lethargy, dizziness, headache, visual disturbances and may progress to seizures, hyperpyrexia, coma, respiratory paralysis and death. Symptoms usually subside between the second and fifth day.

- Radiographic findings consist of perihilar mottling, consolidation, areas of collapse or frank pulmonary oedema. Pleural effusion may develop. Rarely cysts or pneumatocoeles may form. The X-ray abnormality usually clears within 7-10 days but may rarely last for months.

Treatment

Record vital signs and observe for 6-8 hours. If the patient is asymptomatic, it is unlikely that significant problems will occur. If significant symptoms appear, the patient should have a chest X-ray. It may identify pulmonary disease not appreciated by auscultation in up to 60% cases. Liver and renal function tests, urine and electrolytes should be evaluated.

1. Prevention of aspiration is the main goal. **Do not induce emesis**.
2. Lavage with a cuffed endotracheal tube in situ is advocated in comatose patients. If large amount (1-2 ml/kg) is ingested, controlled gastric emptying must be done in an alert patient only by a stomach tube.
3. Instillation of oils to slow gastric emptying and decrease intestinal absorption has not proved to have practical application.
4. Specific treatment is aimed at aggressive correction of hypoxia with humidified oxygen and CPAP (continuous positive airway pressure).
5. Prophylactic antibiotics to prevent secondary bacterial infection may be used.
6. Proper supportive care especially to maintain fluid balance and to prevent hypoxia.

   Value of corticosteroids to prevent chemical pneumonia is doubtful.

Pneumatocoele, pneumothorax, cardiomegaly or arrhythmia may occur occasionally. Recovery is usually complete. However, pulmonary fibrosis and bronchiectasis have been known on long-term follow-up.

DHATURA POISONING

Dhatura stramonium (thorn apple) grows in India at high altitudes. The seeds and fruits are the most poisonous parts of the plant with hyoscine, hyoscyamine and traces of atropine, as the active principles. The dried leaves and dried seeds are used in India, as a substitute for stramonium and belladonna. The drug is commonly used in India for criminal purposes.

SALIENT FEATURES

- Peripheral effects are predominant and result from anticholinergic (parasympatholytic) action. Central effects involve initial stimulation of the CNS, with excitement and restlessness followed by subsequent depression, delirium and coma.

- Within half an hour of taking the poison, gastric irritation starts. The patient complains of a bitter taste, dry mouth and throat, burning pain in the stomach and difficulty in swallowing and talking. This is followed by giddiness, ataxia, incoordination of muscles, a peculiar flushed appearance of the face, dry hot skin, rise in temperature, diplopia, dilated pupils with loss of accommodation, reddening of the conjunctiva and drowsiness. Sometimes, an erythematous rash appears all over the body.
- Usually a full, bounding pulse which later becomes weak and irregular.
- Muttering delirium, tries to run away from the bed, picks at bed clothes, tries to pull imaginary threads from the tips of his fingers and develops dreadful hallucinations of sight and hearing. The condition may pass on to stupor, convulsions, coma and sometimes death from respiratory failure. Death may occur within 4-24 hours.

Treatment

1. The stomach is washed out with 1:10,000 potassium permanganate solution or 5% tannic acid solution.
2. In severe poisoning, only Inj. Physostigmine 1-2 mg IM or IV repeated after half an hour, if necessary. Watch for side effects: bradycardia, heart block, excessive secretions.
3. Inj. Pilocarpine nitrate 6-15 mg injected subcutaneously.
4. Inj. Diazepam may be given for convulsions (see section on Status Epilepticus).
5. For delirium, chloral hydrate, Inj. Paraldehyde or any short-acting barbiturate is usually given.
   (**Caution**: Morphine is contraindicated).

References

1. First Aid during Emergency. National Portal of India. www.India.gov.in reviewed on 8.2.11.
2. poisoning and Drug Over dosage. In: Harrison's Principles of Internal Medicine. Fauci, Braunwald, Kasper et al (eds), 18th Edition, McGraw Hill Company Inc., New York, 2012; E281-E296.

OPIOID INTOXICATION

Opioid overdose can be a medical emergency and is usually accidental. It can result from incorrect estimation of dose or erratic pattern of use in which person has lost previous tolerance to drug. Often caused by combined use with other CNS depressants, e.g. alcohol or sedative hypnotics.

SALIENT FEATURES

- Pinpoint pupils, respiratory depression and CNS depression, decreased gastrointestinal motility, analgesia, nausea and vomiting, slurred speech, hypotension, bradycardia and seizures.

Treatment [immediate admission in intensive care unit (ICU)]

1. Establish adequate airway and respiration. Oxygen inhalation and IV fluids. If facilities are available, give artificial ventilation.
2. Activated charcoal 1g/kg suspended in water, if ingestion of large doses of oral opioids is suspected.
   Or
   Gastric lavage to remove any remaining drug.
3. Inj. Naloxone 0.4-2 mg IV or IM (0.01 mg/kg for neonates) and response should occur in 1-2 min, if needed dose can be repeated every 2-3 min up to 10 mg. If no response to 10 mg, it is unlikely due to opioids except in case of buprenorphine or suspect another diagnosis. Titrate dose relative to the patient's symptoms to ameliorate the respiratory depression but not provoke a severe withdrawal state. If successful, continue at 0.4 mg every hour IV until the opioid has been cleared (at least for 24 hours for heroin and 72 hours for methadone overdose). Babies born to opioid-abusing mothers may experience intoxication, overdose or withdrawal.
4. Always consider possible polysubstance overdose. A patient successfully treated with naloxone may wake up briefly only to succumb to a subsequent overdose from another slower acting drugs, e.g. sedative-hypnotic taken simultaneously. Give Inj. Flumazenil 0.2 mg/min (max 3 mg in an hour) (**Caution**: It might precipitate seizures and increase intracranial pressure).
5. Supportive measures for respiration, hypotension with pressor agents and cardiac arrhythmia.
6. Body warmth to be maintained with hot water bottles.
7. If convulsions are present, Inj. Diazepam 10 mg IV and repeated as required (for details see section on Status Epilepticus).
8. ***The patient should not be made to walk forcibly in opium poisoning***, as it is frequently done, but attempts should be made to keep him awake, by flicking a wet towel on the face.

References

1. First Aid during Emergency. National Portal of India. www.India.gov.in reviewed on 8.2.11.
2. Opioid Drug Abuse and Dependence. In: Harrison's Principles of Internal Medicine. Fauci, Braunwald, Kasper et al (eds), 18th Edition, McGraw Hill Company Inc., New York, 2012; pp 2729-2732.

TRAUMA

Cardiac arrest associated with trauma

Survival rates of 0 to 3.7% are reported for victims of traumatic cardiac arrest. Resuscitation of this patient group is, therefore, considered by many to be futile and an inappropriate use of resources. Consider if there are reversible causes of cardiac arrest and treat which include hypoxia, hypovolaemia, diminished cardiac output secondary to pneumothorax or pericardial tamponade, and hypothermia.

BLS modifications

When multisystem trauma is present or trauma involves the head and neck, the cervical spine must be stabilized. A jaw thrust should be used instead of a head tilt–chin lift to establish a patent airway. If breathing is inadequate and the patient's face is bloody, ventilation should be provided with a barrier device, a pocket mask, or a bag-mask device while maintaining cervical spine stabilization.

Stop any visible haemorrhage using direct compression and appropriate dressings. If the patient is completely unresponsive despite rescue breathing, provide standard CPR and defibrillation as indicated.

ACLS modifications

After initiation of BLS care, if bag-mask ventilation is inadequate, an advanced airway should be inserted while maintaining cervical spine stabilization. If insertion of an advanced airway is not possible and ventilation remains inadequate, experienced providers should consider a cricothyrotomy.

If unilateral decrease in breath sounds during positive-pressure ventilation, consider the possibility of pneumothorax, hemothorax, or rupture of the diaphragm.

When the airway, oxygenation, and ventilation are adequate, evaluate and support circulation.

Control ongoing bleeding where possible and replace lost volume, if the losses appear to have significantly compromised circulating blood volume. Cardiac arrest resuscitation will likely be ineffective in the presence of uncorrected severe hypovolaemia.

Treatment of pulseless electrical activity (PEA) requires identification and treatment of reversible causes, such as severe hypovolaemia, hypothermia, cardiac tamponade, or tension pneumothorax. Development of bradyasystolic rhythms often indicates the presence of severe hypovolaemia, severe hypoxaemia, or cardiorespiratory failure. Ventricular fibrillation (VF) and pulseless ventricular tachycardia (VT) are treated with CPR and defibrillation.

In cardiac tamponade in traumatic cardiac arrest, consider emergency department thoracotomy.

Commotio cordis

Commotio cordis is VF triggered by a blow to the anterior chest during a cardiac repolarization. Blunt cardiac injury may result in cardiac contusion with injured myocardium and risk of ECG changes and arrhythmias. Even a small blow to the anterior chest during a cardiac repolarization, such as that imparted by the strike of a baseball or hockey puck, may trigger VF, so-called commotio cordis. Events causing commotio cordis are most commonly seen in young persons up to 18 years of age who are engaged in sports but may occur during daily activities.

Prompt recognition that a precordial blow may cause VF is critical. Rapid defibrillation is often life-saving for these frequently young victims of cardiac arrest.

Provide immediate BLS care using an automated external defibrillator (AED) and ACLS for VF.

THORACIC TRAUMA

Thoracic trauma is responsible for one-fourth of civilian trauma deaths. Two-thirds of these deaths occur after reaching the hospital. Deaths can be prevented by prompt transportation, diagnosis and correct management.

Most thoracic traumas do not require thoracotomy but rather simple life-saving manoeuvres of airway control, rapid infusion of fluids and tube thoracostomy are needed. The trauma can be penetrating or blunt.

Blunt trauma causes injury to the chest by the following mechanisms:

1. Direct blow, e.g. rib fracture.
2. Deceleration injury, e.g. pulmonary contusion.
3. Compression injury, e.g. cardiac and diaphragm injury.

SALIENT FEATURES

- Chest pain and shortness of breath. Careful physical examination of the patient is important especially in the management of patient with equivocal radiological investigation.

Management

(a) Resuscitation. Assess for the patency of airway, breathing and circulation. Ensure the patency of the airway and adequacy of ventilation. Insert two 16G intravenous cannulae and start resuscitation with crystalloid. If haemothorax or a pneumothorax are suspected in a patient with acute respiratory distress, chest tube should be inserted through the 4th/5th intercostal space in the anterior axillary line on the affected side without waiting for chest radiography.

(b) Quick assessment of injuries.

Treatment of specific injury

1. Chest wall

(a) Rib fracture can vary from simple fracture to fracture with haemo-pneumothorax, to severe multiple fractures with flail chest and internal injuries. In case of simple fractures, pain with inspiration and localized tenderness and occasional localized crepitus on examination are present. Diagnosis is confirmed with a chest X-ray anteroposterior view. Exclude other intrathoracic injuries. Patients are treated with adequate analgesic drugs and muscle relaxants. In cases of multiple fractures, intercostal nerve blocks or epidural analgesia is required to ensure adequate pain relief and ventilation. Elderly patients need admission for pain relief, ventilation assistance and observation.

(b) Flail chest occurs due to unilateral fracture of 4 or more ribs, both anteriorly and posteriorly; and bilateral anterior or costochondral fracture of more than 4 ribs causes a paradoxical respiratory motion. It leads to hypoventilation, atelectasis, hypercapnia and inadequate ventilation (RR > 40/min, pO_2< 60 mmHg with 60% FiO_2). It requires immediate endotracheal intubation and ventilatory support.

2. Pleural space

(a) Haemothorax should be suspected with penetrating or severe blunt thoracic injury. It is classified according to the amount of blood collected inside the pleural cavity and more importantly rate of bleeding after evacuation. In 85% of the patients with haemothorax, only tube thoracostomy is required. After tube thoracostomy, if the rate of continuing haemorrhage is more than 100-200 ml/hour or the haemorrhagic output exceeds 1000 ml in 24 hours, thoracotomy should be performed.

(b) Pneumothorax is a true surgical emergency requiring immediate diagnosis and chest tube insertion. Subcutaneous emphysema, absent breath sound, mediastinal shift and acute respiratory distress warrant immediate chest tube insertion without waiting for a chest X-ray examination. Sucking chest wounds, which allow air to pass in and out of the pleural cavity, should promptly be treated by closure of the wound (initially sealing with large pads and later with suturing) and concomitant tube thoracostomy. Simple pneumothorax (without tension) should also be managed by chest tube insertion but only after documentation by chest X-ray.

3. Lung injury

(a) Pulmonary parenchymal injury can be effectively managed nonoperatively, but about 15% of penetrating lung injury requires thoracotomy for control of haemorrhage. Approximately 80-90% of pulmonary injuries requiring operation can be managed by simple suturing or stapling of the involved segments. Only 10-20% cases require anatomical lung resection.

(b) Pulmonary contusion in most patients with flail chest can also appear without any evidence of rib fracture (particularly in children). Treatment is often delayed because clinical and X-ray findings may not appear until 12-24 hours after injury.

Clinical findings are loose, copious, blood tinged secretions, chest pain, restlessness, and laboured respiration. X-ray changes consist of patchy parenchymal opacification or diffuse peribronchial densities.

Management involves careful pulmonary support and clearing of secretions, with ventilatory support, if arterial blood gases cannot be maintained in a physiologic range. Positive end-expiratory pressure (PEEP) is a useful adjunct in the management of those requiring ventilation. Fluid overload should be avoided.

4. Trachea and bronchus

Tracheobronchial injuries should be suspected, when there is a massive air leak or when the lung does not readily expand after chest tube placement. In most patients having pneumothorax, subcutaneous emphysema, pneumo-mediastinum, and haemoptysis,

diagnosis may require tracheobronchoscopy. When diagnosis is confirmed, thoracotomy and primary repair is advised.

5. Heart and pericardium

Cardiac tamponade can occur both from blunt and penetrating cardiac trauma. Tamponade in blunt trauma is often due to myocardial rupture or coronary artery laceration. Patient presents with chest pain, distended neck veins, shock and cyanosis. Treatment includes immediate thoracotomy, pericardial decompression and repair of injuries.

6. Oesophagus

Anatomically, the oesophagus is well protected, and perforation from external wounds is relatively infrequent. The most common symptom of oesophageal perforation is pain; fever develops within hours in most patients. Regurgitation of food, hoarseness, dysphagia or respiratory distress may be present. Physical findings include shock, local tenderness, subcutaneous emphysema, or Hamman's sign. X-ray findings on plain chest films include evidence of foreign body or missile and mediastinal widening or air. Contrast studies (urograffin, not barium) confirm the diagnosis. Treatment consists of early recognition (24-48 h), closure of oesophageal perforation and pleural drainage. Old perforation may require advanced surgical management and should be referred to a specialized centre.

Reference

1. Thoracic Injury and Sepsis. In: Hamilton Bailey's Emergency Surgery. Ellis BW, Paterson-Brown S. Arnold (eds), 13th Edition, London, 2000; pp 285-288.

BLUNT ABDOMINAL TRAUMA

The presentation varies from innocuous injury with no symptoms or signs of a severe injury presenting with peritonitis or shock or even causing death before reaching the hospital. The management depends upon the condition at presentation:

1. Immediately transfer the patient to the hospital along with intensive monitoring, where facilities for operation are available after providing first-aid treatment for bleeding and shock. Evaluate for head injury and intrathoracic injuries.
2. Immediate exploratory laparotomy should be done, if the patient is in shock, has rigid distended abdomen, evidence of peritonitis or evisceration of the bowel.

(a) Diagnostic peritoneal lavage (DPL). In patients with trauma who are hypotensive with possible intra-abdominal bleeding when focused abdominal sonography for trauma (FAST) capability is not available, Hypotensive patients should not be evaluated with CT scanning. In the absence of CT scanning, DPL is also useful in patients with unreliable physical examination due to altered sensorium (injury to brain, ingestion of alcohol or drugs), loss of sensation (injury to spinal cord) or injuries to adjacent structures (pelvis, ribs, dorsolumbar spine):

- Insert nasogastric tube and urinary catheter.
- Use an infraumbilical incision (supraumbilical, if patient has pelvic fracture).
- Lavage is considered positive, if you get 10-20 ml non-clotting blood or bile, succus entericus, stool or food material.

In a hypotensive patient with grossly negative 'tap' (i.e. no fresh blood aspirated), the value of time-consuming lavage with 1000 ml of saline and its evaluation by microscopy (often not available) is questionable.

(b) Contrast-enhanced computed tomography (CECT) of abdomen should be performed in patients who are haemodynamically stable and in whom physical examination is unreliable because of the above mentioned factors. If CECT detects diaphragmatic injuries, intraperitoneal or retroperitoneal free air, contrast extravasation from bowel, disruption of pancreas, urinary bladder injury or grade IV or V injuries of liver, spleen and kidney with hot spot (active haemorrhage), exploratory laparotomy should be performed.

Patients with lesser grades of liver or splenic injuries can be managed conservatively, provided intensive monitoring facilities and facility for immediate exploration, should the need arise, are there.

It must be reiterated that during conservative management, these patients need intensive monitoring and frequent reviews by an experienced surgeon. If these are not available or there is doubt about the nature of injuries, exploration is safer. When CT scan is not available, chest X-ray in erect posture, plain X-ray films of abdomen and contrast studies of the bowel or urinary tract as and when indicated will detect all the injuries except injuries to liver, spleen and pancreas. Ultrasound examination can help to detect solid organ injuries, collections in the peripheral cavity, etc. Imprint abrasions or patterns of injury are the marks of ecchymosis due to restraint devices like seat belts. When present, they often are signs of serious intra-abdominal injuries especially to hollow viscous or to lumbar spine.

References

1. Maingot's Abdominal Operations. Zinner MJ, Schwartz SI, Ellis H. (eds), 10th Edition, Prentice Hall International, 1987; pp. 763-786.
2. Abdominal trauma. In: Hamilton Bailey's Emergency Surgery. Ellis BW, Paterson-Brown S. Arnold (eds), 13th Edition, London, 2000.
3. Jill S Whitehouse and John A Weigelt, Diagnostic Peritoneal Lavage: A Review of Indications, Technique, and Interpretation. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine 2009, **17**:13 doi:10.1186/1757-7241-17-13. http://www.sjtrem.com/content/17/1/13.

PENETRATING STAB INJURIES

The management depends upon the site of injury.

I. Anterior abdominal wall (between two axillary lines)

A. Immediate exploratory laparotomy, if patient is in shock at the time of presentation with rigid distended abdomen, peritonitis or evisceration.

B. Wound exploration in operation theatre with good illumination in haemodynamically stable and cooperative patients. If anterior fascia (in obese patients) or peritoneum (in thin patients) is not breached, wound can be closed after irrigation and patient can be discharged and followed up in the OPD.
C. If wound exploration reveals breach of anterior fascia or peritoneum but the abdomen does not have evidence of peritonitis, the patient can be admitted and serially examined for 24 hours. This method can delay definitive operation in about 5-10% of patients. The other option is to perform diagnostic peritoneal lavage (DPL). DPL in stab injuries has slightly higher false positive results (as compared to blunt abdominal trauma) because of bleeding from the site of stab wound. It can also miss some hollow viscous injuries especially of colon, if patient presents early and hence DPL is performed very early.
D. In the sub-group of patients in whom there is high suspicion of intra-abdominal injury, but the patient is haemodynamically stable on presentation, perform diagnostic laparoscopy. It can confirm or rule out intra-abdominal injury without needing a laparotomy. However, it must be performed by a surgeon experienced in laparoscopy.

II. Stab wound of the flank (between anterior and posterior axillary lines from sixth intercostal space to iliac crest) and back (posterior to posterior axillary line between tip of scapula and iliac crest).

In haemodynamically stable and cooperative patients

Wound exploration in operation theatre with good illumination. If anterior fascia (in obese patients) or peritoneum (in thin patients) is not breached, wound can be closed after irrigation and patient can be discharged. In patient where the end of the wound track cannot be reached (because of thick musculature in that area), patient should be admitted and serially examined for 24-48 h. If any sign(s) of intra-abdominal injury are obvious, laparotomy should be performed. This method can delay definitive operation in about 5-10% of patients. The other option in these patients is to perform triple contrast CECT (intravenous, oral and rectal), and proceed according to the findings. This has an overall accuracy of 96-97%.

III. Gunshot wounds of the abdomen

Most of the patients of gunshot wounds of the abdomen need immediate exploratory laparotomy since visceral or vascular injuries that need surgical repair are seen in more than 95% of these patients. However, if patient presents late and is haemodynamically stable and have no signs of peritonitis, the patient can be serially examined or subjected to triple contrast CECT before deciding for conservative treatment.

References

1. Abdominal Trauma and Indications for Celiotomy. In: Trauma. Moore EE, Mattox KL, Feliciano DV, Appleton and Lange (eds), 2nd Edition, 1991; pp. 409-426.

2. Blunt and Penetrating Abdominal Trauma. In: Maingot's Abdominal Operations, 10th Edition. Prentice Hall International, 1987; pp 763-786.

CHEMICAL BURNS OR INJURIES OF THE EYE

Chemical injuries due to entry of alkaline or acidic materials may result in potentially serious ocular damage including permanent visual loss and cosmetically unsightly eye. Alkalies cause extensive damage due to their ability to readily penetrate inside the eye. Most acid burns cause mild ocular damage because they tend to coagulate and precipitate proteins which act as barrier for further penetration of acids. Depending upon the concentration and degree of penetration, there may be injury to the conjunctiva, cornea, limbal stem cells, episclera, sclera, uvea, lens and eyelid, etc.

SALIENT FEATURES

- Clinical manifestations vary according to the extent of ocular surface injury: Congestion and chemosis of conjunctiva, corneal epithelial damage, total loss of corneal epithelium, corneal hazziness or totally opaque cornea, limbal ischaemia, anterior uveitis, cataract and rise in intraocular pressure (IOP), lid injury, symblepharon.
- Complications include non-healing epithelial and stromal ulceration, corneal perforation, corneal melting, sequelae vascularized opaque cornea, cataract, glaucoma, symblepharon, dry eye, eyelid deformities, phthisis bulbi.

Treatment (at the site of injury)

Irrigate the eye (conjunctival sac) with any innocuous liquid water and continue for at lest 10 min. The face may be plunged into a water container and then open the eyes under water.

Treatment in the hospital

1. Irrigation in the hospital—retract the eyelids and irrigate the conjunctival sac with normal saline or Ringer's lactate or water using intravenous tubing connected to the irrigating solution for 30 minutes or until litmus paper touched to the inferior fornix indicates neutrality.
   (**Caution:** Do not try to neutralize the alkali with acids or vice versa)
2. Remove retained solid particles of lime, or any other material from superior and inferior fornix after anaesthetizing the conjunctiva. It may require double eversion of eyelid and use of forceps. If double eversion is not possible, a moistened cotton-tipped applicator should be swept in the fornix.
   Sodium ethylene diamine tetra-acetic acid (EDTA) 0.01 to 0.05 molar solution may be used as an irritant to dissolve calcium hydroxide.

Pharmacological (acute phase 1st week)

1. Homatropine eyedrops 2% 3 times a day.
2. Gentamicin eyedrops 0.4% 4 times a day.
   Or
   Ciprofloxacin eyedrops 0.3% 4 times a day.
3. Tab. Ibuprofen 400 mg, if required.
   Patch the eye and refer to an ophthalmologist.

Surgical therapy

Debridement, tenoplasty, limbal stem cell transplantation, keratoplasty, keratopresthesis, etc.

Reference

1. Manual of Ocular Diagnosis and Therapy, 4th Edition, Little Bran and Company, 1996; pp. 32-33.

FOREIGN BODY IN THE EYE

This could be a small insect or a piece of grit or a loose eyelash.

SALIENT FEATURES

- Acute pain, redness and watering in the affected eye.

Treatment (at the site of injury)

Nonpharmacological

Not to rub the affected eye. If possible, make the patient blink the eyelids, with the eye under clean water. If this is not effective, make the patient sit in good light, wash your hands with soap and water and try to remove the foreign body gently by flushing the eye with clean water or saline. For foreign body under the upper eyelid, turn the eyelid up and identify the foreign body and then remove it gently with moistened and twisted cotton wool or a clean piece of cloth. In case the foreign body is in the lower lid, gently draw the lower lid down and identify the particle and remove it with a moistened wisp of cotton. After removal, ciprofloxacin eye ointment/eyedrop should be applied and the eye should be bandaged. In case the foreign body cannot be removed or corneal perforation occur immediately refer to a higher centre.

BLACK EYE

Black eye is a collection of blood and fluid in the space around the eye, under the skin leading to swelling and dark discolouration of the skin. It results due to injury/blow to face or head or as a result of surgical procedure on face and head injury.

SALIENT FEATURES

- The eye itself is usually not injured, subconjunctival haemorrhage may be present.
- Injury to nose or basilar skull fracture causes bilateral black eyes.
- Signs of associate serious eye injury are double vision, loss of vision, loss of consciousness, inability to move the eye, blood on surface of eye itself, lacerations or cuts on the eyelids, or injury with penetrating object.
- Following tests to be performed: Visual acuity, pupil and outer examination, ocular movements, fluorescence staining, X-ray orbits, orbital bones and CT scan orbit for suspected fracture or foreign body.

Treatment

Most black eyes are minor injuries that heal spontaneously in 1-2 weeks with icepacks for 24-48 hours, rest and protection of injured area with instructions to contact the doctor immediately, if the patient experiences any change in or worsening of symptoms.

Swelling either after a bee sting near the eye or from a suspected infection of the eye should be evaluated by a doctor.

Seek immediate medical care in case of symptoms of serious eye injury as above and who are on warfarin or suffer from haemophilia. An ophthalmologist should examine especially if injuries to the eye itself or fracture of the orbital bones to ensure no significant eye injury. For other associated injuries, refer patient to neurosurgeon, ENT surgeon or plastic surgeon.

Nonpharmacological

As soon as possible apply cold pack or ice wrapped in cloth (Do NOT apply direct ice) to constrict blood vessels and localize bleeding. Do not press on eye while applying cold pack.

Sleep with head elevated on 2 pillows to decrease swelling of eyes. Wear dark glasses to reduce eye strain during healing.

Pharmacological

If pain relief is required, avoid aspirin as it may increase bleeding.

Patient education

- Avoid black eye with basic injury prevention
- Wear protection gear and seat belts while driving.

References

1. Maloney GE, Fraser WR. In: Medicine Health. Allesson RW, Graham RH (eds). American Academy of Ophthalmology, 2005.

2. Black Eye: First aid. In: First Aid Guide. Mayo Foundation for Medical Education and Research, 2007.
3. Black Eye Causes, Symptoms, Diagnosis, Treatment. http://www.emedicinehealth.com/black_eye/article_em.htm accessed on 19.9.12.

FRACTURES

A fracture is a break in the structural continuity of a bone. It is termed as an open (compound) fracture, if there is a concomitant wound through which the fracture site communicates to the environment. If the fracture does not communicate to the environment, it is called as close fracture.

SALIENT FEATURES

- Pain, swelling, tenderness, loss of function, deformity, shortening, crepitus, abnormal mobility and loss of transmitted movement, singularly or in combination.

Treatment

Only observe but do not elicit these signs by purposefully manipulating the limb at the site of accident or injury.

Emergency care of fractures at the site of accident (first aid)

- All trauma patients with a cervical spinal column injury or with a mechanism of injury having the potential to cause cervical spinal injury should be immobilized at the scene and expeditiously transported to nearest hospital using one of several available methods – a combination of a rigid cervical collar and supportive blocks on a backboard with straps.
- ***If injury to the spine is suspected, carefully move the person from the site of accident in one piece like a log of wood without any twisting or flexion.***
- Give temporary immobilization (called splintage) after grossly correcting the deformation without moving or manipulating much with either wooden stick/an umbrella/a folded magazine or newspaper, a fractured lower limb temporarily can be supported and tied with opposite lower limb for splintage and transfer of patient; a fractured upper limb can be splinted by supporting it on the chest wall and wrapping any cloth piece around it. Take a note of the colour of the finger or toes before applying splintage.
- If the patient has an open fracture with excessive bleeding, avoid trying any circumferential ligature to any part of the limb to stop the bleeding (unless the bleeding is life-threatening) as the ligature can be more injurious to the distal circulation of the limb.

Care of patient in the emergency department

The general aim of early fracture management is to control haemorrhage, provide pain relief, prevent ischaemia-reperfusion injury, and remove potential sources of contamination (foreign body and nonviable tissues).

(a) Patient with fracture in an extremity. Splint the limb with either Crammer wire (a malleable metallic support) or a slab or goose splint (thin layers of wood adhered to cloth) or a Thomas splint (for femoral fractures) or Bohler Braun splint (for fractures around the knee or leg bones fractures); include the proximal and the distal joint of the fractured segment of the limb in splintage (Table 2.11).

Table 2.11. Splinting in injured/fractured part of the limb

Injured/fractured part of limb	Extent of splintage
Fingers (phalanges)	Support with adjacent finger (called Buddy strapping).
Hand (metacarpals)	Terminal pulp of fingers to proximal third of forearm.
Wrist (carpals or lower end or radius or ulna)	Distal palmar crease to upper one-third-forearm.
Elbow and forearm (lower end humerus or upper end of radius or ulna)	Distal palmer crease to upper one-third of arm.
Arm (humerus)	Middle one-third of forearm to base of neck (include shoulder).
Foot and ankle (tarsals or metatarsals)	Base of toes to upper one-third of leg.
Leg (tibia or fibula)	Base of toes to upper one-third of thigh (include knee and ankle). Can apply Bohler-Braun splint also.
Knee (lower end of femur or upper end of tibia)	Just above the malleoli to upper one-third of thigh.
Thigh (femur)	Base of toes to nipple line on trunk. The better option is application of Thomas splint.
Pelvic	See section on pelvic fractures.

(b) Any open wound is dressed before application of splintage. For wounds of open fractures, irrigation of the wound with copious amount of saline (0.9% NaCl) helps to remove dirt and foreign particles/bodies. The definitive treatment should be provided by an orthopaedic surgeon after radiological examination.

(c) Multiple injuries. Remove clothing and examine the patient rapidly from head to toe.

- Ensure patency of the airway.
- Perform throat suction, if secretions are present in the throat.
- The neck may be "gently" turned to one side to prevent aspiration and ensure patent airway and breathing.

- Check for pneumothorax or a flail segment and take appropriate measures (see section on Thoracic Trauma for details).
- Record vital parameters. Assess the level of consciousness according to Glasgow Coma Scale. Establish intravenous line and catheterize the patient (see section on Coma for details).
- Splint the limbs and note down distal neurovascular status. The patient, if required to be shifted, is handled with great care as patient might be having spinal injury.

Pharmacological

1. Inj. Diclofenac sodium 75 mg IM stat for pain relief.
   (**Caution**: Do not give any sedative or centrally acting analgesic
   (like morphine or its derivatives); to keep a watch on their level of consciousness and early detection of any complication arising secondary to any fracture in the limb).
2. Inj. Tetanus toxoid 0.5 ml IM stat, if open injuries or wounds.
3. IV fluids for management of haemorrhagic shock (see section on Shock). Give an initial rapid fluid bolus of 1-2 liters of Ringer's lactate in the adult patient and 20 ml/kg in the paediatric patient. Send blood for grouping and cross-matching.
4. Catheterize the patient for measuring urine output as the latter is one of the most reliable clinical parameters to assess the adequacy of visceral perfusion and it also helps in the assessment of IV fluid to be transfused.
5. In case of open fractures, give intravenous antibiotics after sensitivity testing. Various combinations can be used but each should provide coverage for Gram-positive as well as Gram-negative organisms. The antibiotics should be continued for at least a period of 7-14 days.
   Inj. Cloxacillin 500 mg 6 hourly (50-100 mg/kg in children)
   Inj. Gentamicin 80 mg 12 hourly (5-7.5 mg/kg in children)
   Or
   Inj. Cefotaxime 1 g 12 hourly (100-200 mg/kg in children)
   Inj. Amikacin 500 mg 12 hourly (15 mg/kg in children)
   Or
   Inj. Ceftriaxone 1 g 12 hourly (50-100 mg/kg in children)
   Inj. Amikacin 500 mg 12 hourly (15 mg/kg in children)
   The patient or parents should report to the hospital in case of:
   - Severe pain in the limb,
   - Difficulty in moving fingers/leg or has sense of numbness, fingers/toes are swollen,
   - Any change in the colour of toes or finger nails, i.e. pale, dusky or blue,
   - Rashes on skin under plaster in perineal or buttock; in case of vomiting or abdominal distension developing in a patient with a spica cast,
   - Pain in a localized area with discolouration of the distal organ, or reappearance of swelling (could be because of plaster sore) or
   - If the plaster cracks, breaks or becomes soft.

The goal in managing fractures is to ensure that the involved limb segment, when healed, has returned to its maximal possible function. Exercises are initiated according to the recommendations of the treating physician and based on tissue healing. Therapy should begin with gentle range of motion and progress to strengthening exercises as tolerated. Intensity and duration of exercises should be advanced as indicated.

Patient education

- Following points should be explained to the patient after application of a plaster:
  - The plaster immediately after application feels warm/hot during setting. Don't cover the plastered limb with clothing or bed sheet to allow the plaster to dry and to permit direct observation of the limb.
  - Keep the limb elevated and keep on moving toes/fingers frequently.
  - In children to cover the edges of the plaster with waterproof material like polythene or plastic adhesive tape to avoid soiling of a hip spica or GT cast with urine or faeces.
  - Not to bear weight on plaster unless permitted by the doctor, otherwise it gets spoiled/cracked.
  - Avoid resting the plaster over any edge or hard surface to avoid dents and plaster sore.
- Explain a home exercise programme to the individual to complement supervised rehabilitation.

References

1. Principles of Fractures and Dislocations. In: Rockwood and Green's Fractures in Adults. Charles A, Rockwood Jr, David P Green, Robert W Bucholz et al (eds), 4th Edition, Volume 1, Lippincott-Raven, Philadelphia, New York, 1996.
2. Complications of Fractures. In: Rockwood and Green's Fractures in Adults. Charles A, Rockwood Jr., David P Green, Robert W. Bucholz et al (eds). 4th Edition, Volume 1, Lippincott-Raven, Philadelphia, New York, 1996.
3. Fractures-AAOS-American Academy of Orthopaedic Surgeons. http://orthoinfo.aaos.org/ Accessed on 19.9.12.

PELVIC FRACTURES

Classification

Pelvic fractures are generally divided into two types based on amount of energy involved:

i. Low energy fractures resulting in isolated fractures of individual bones of pelvis without disruption of pelvic ring.
ii. High energy fractures generally producing pelvic ring disruption.

Evaluation

Evaluate the patient with attention to ABC of trauma care (i.e. airway, breathing and circulation). Conduct a primary survey and note baseline vital signs and neurological status.

- Assess pelvic stability, very carefully, by pushing anterior superior iliac spines towards each other and then apart (preferably perform this manoeuvre once only).
- Perform perineal and digital rectal examination.
- Secondary detailed survey is carried out once the patient's condition is stable and X-rays and other relevant investigations are done.

Treatment

As a primary aid, pelvis can be quickly and temporarily stabilized by wrapping a sheet tightly around it. Isolated stable pelvic bone fractures are treated by bed rest (for symptomatic duration) and analgesics, followed by gradual mobilization and weight bearing.

Treatment of unstable pelvic ring disruptions (Fig. 2.9) includes:

- Volume replacement (see section on Shock).
- Control haemorrhage—Apply pressure dressing for conspicuous external bleeding. Open pelvic fracture wounds can be packed to control bleeding. Apply external fixator as a resuscitative measure in patients with demonstrable haemodynamic instability after an initial fluid bolus.
- As an alternative to fixator, pelvic clamp can be applied, but it is not a popular modality as complication rate with this clamp is higher than fixator (**Caution:** Pelvic clamp is contraindicated for iliac wing fracture close to the sacroiliac joint).
- Urological management—Catheterize the urinary bladder to document urinary output as a crucial determinant of adequate volume resuscitation. Blood at urethral meatus/inability to void urine/perineal haematoma/high riding prostate indicate uretheral injury. Microscopic haematuria indicates bladder contusion.

Further management is required in consultation with general surgeon.

(a) Gastrointestinal injuries: Concomitant small bowel/large bowel/rectal/anal tears or perforation can occur. Peritoneal lavage and abdominal CT are required to exclude GI trauma with close pelvis fractures (For details see section on Trauma).

Reference

1. Fractures and Dislocations of the Pelvic Ring. In: Chapmans Operative Orthopaedics. Chapman MW (ed) Lippincott Williams and Wilkins 2000.

SNAKE BITE

There are more than 2000 species of snakes in the world and about 216 species are found in India out of which 52 are poisonous. It is estimated that annually about 2

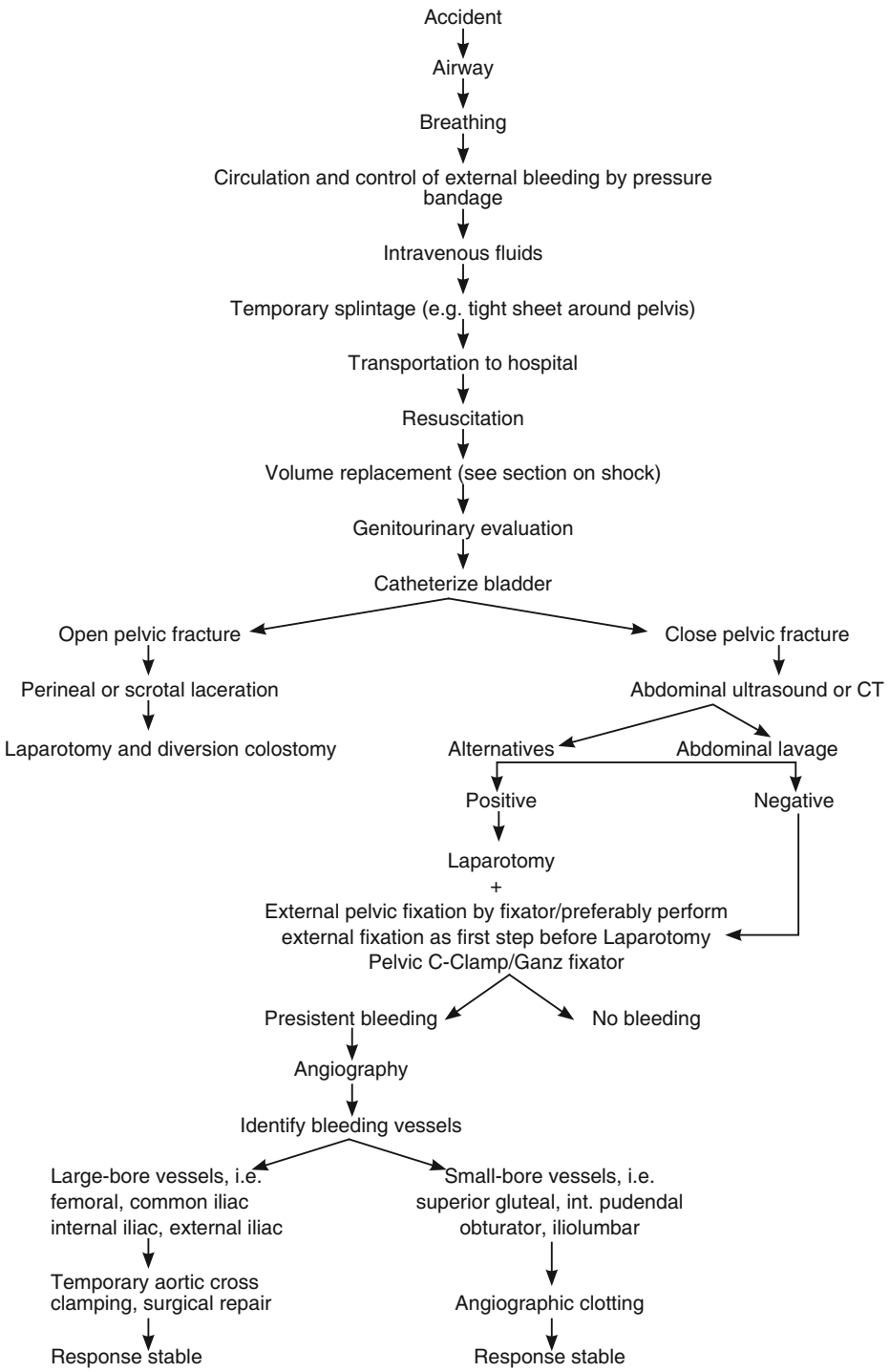


Fig. 2.9. Pelvic fractures: Therapeutic measures for the control of haemorrhage.

lakhs people are bitten, of whom around 16,000 die. The poisonous snakes found in India belong to the families Elapidae and Viperidae. The most common Indian elapids are Naja naja (Indian Cobra) and Bungraus coeruleus (Indian Krait), Viper russelle (Russells' Viper) and Echis carinatus (saw scaled viper).

SALIENT FEATURES

- Although manifestations of the envenomization are complex, signs of neurotoxic effects predominate in patients bitten by elapids, while signs of vascular damage and alterations of blood coagulation are prominent features of a viperid bite.

Elapid envenomization (neurotoxic)

In the case of a cobra bite, pain and numbness at the site of the bite and lassitude and drowsiness followed by a sense of clouding consciousness, growing dimness of vision, difficulty in breathing, weakening of pulse, tachycardia, drooping of eyelids and difficulty in speech. In the initial stages, there is dribbling of saliva, paralysis of the tongue and laryngeal muscles, and the patient passes into coma. At this stage, respiration ceases and convulsions appear, but the heart continues to beat for some time after respiratory paralysis. Symptoms of krait envenomization are almost similar, but pain and swelling may be absent at the site of the bite with the result that even a suspicion of snake bite may not be aroused. Later on, however, the patient may complain of severe cramp-like pains in the abdomen.

Viperine envenomization (haemovasculotoxic)

After a viperid bite, there is a burning pain at the site, oedema accompanied by a painful lymphangitis and regional lymphadenitis, bluish purple tinge in the affected area 12 hours or more following the bite, with petechial haemorrhages and haematoma. This haemorrhagic tendency may result in epistaxis, melaena, haematemesis and haematuria. In severe cases, vomiting and incontinence of faeces and urine may be seen followed by a fall in blood pressure resulting in an acute excitatory collapse, ending in death.

Diagnosis

A bite from a venomous snake may show one or more punctures, a small abrasion and perhaps a linear laceration. Unless there is a semicircular row of teeth marks, the bite may not be assumed to be that of a nonvenomous snake. The pattern of fang marks is, however, of no help in ascertaining the amount of venom injected, severity of systemic poisoning and nature of poisoning—Elapidae or Viperidae venom. A local swelling appearing within a few minutes after the bite is an important sign of viper envenomization. The local sucking may also occur in the Indian cobra bite, although it usually does not appear until after 1-2 hours.

The important early diagnostic criteria of systemic viper poisoning are blood-stained sputum and nonclotting of blood. The early signs of an elapid envenomization are ptosis and glossopharyngeal palsy.

Treatment

The aim is rapid and safe transport to a place where optimal medical care is available.

(**Caution**: Do NOT make local incisions or pricks/punctures ("tattooing") at the site of the bite or in the bitten limb, attempts to suck the venom out of the wound, use of (black) snake stones, tying tight bands (tourniquets) around the limb, electric shock, topical instillation or application of chemicals, herbs or ice packs).

I. First aid measures

1. Ensure airway, breathing and intravenous access.
2. Reassurance.
3. Keep the patient warm, and at rest. Activity may enhance the spread of venom.
4. Immobilize the whole of the patient's body by laying him/her down in a comfortable and safe position and, especially, immobilize the bitten limb with a splint or sling. Any movement or muscular contraction increases absorption of venom into the bloodstream and lymphatics.
5. Avoid any interference with the bite wound (incisions, rubbing, vigorous cleaning, massage, application of herbs or chemicals) as this may introduce infection, increase absorption of the venom and increase local bleeding.
6. For pain, a mild, nonsedating analgesic can be administered (aspirin or paracetamol).
7. A tourniquet (constricting band in the form of a strap or belt, etc.) can be applied lightly proximal to the bitten site to prevent lymphatic spread. It should be capable of admitting a finger beneath it. It is used till the patient is shifted to the hospital and approximately tied 10 cm above the bite. Once applied, the tourniquet should be loosened or removed only after antivenom administration has begun. A recent suggested modification to the tourniquet is a broad, firm constrictive bandage (elastic bandage) wrapped over the bitten area, including the entire limb with the limb placed in a splint. Tight (arterial) tourniquets are not recommended.
8. Wipe the bitten site and cover loosely with a piece of clean cloth.

II. Identification of snake

One or more of the following features indicate poisonous nature, if snake is available for examination, however, do not attempt to kill it as this may be dangerous:

1. Oval head with large scales (shields) or triangular head with small scales.
2. Broad ventral scales extending completely across the belly.
3. Tail short and tapering abruptly.
4. Scales on the undersurface of the tail (subcaudate) divided.
5. Third supralabial shield (i.e. upper lip scale) is the largest of the supralabials.
6. Fourth infralabial shield (i.e. lower lip scale) is the largest of the infralabials.
7. Presence of control row of hexagonal vertebral scales.

8. Presence of hood in the neck.
9. Presence of fangs (i.e. modified long teeth, usually in the upper jaw, which may be grooved or channelized. Usually 2 in number, they are connected to the poison gland).

III. Hospital measures

Check arterial pulse and level of consciousness immediately. However, the Glasgow Coma Scale cannot be used to assess the level of consciousness of patients paralyzed by neurotoxic venoms.

Early clues that a patient has severe envenoming:

- Snake identified as a very dangerous one.
- Rapid early extension of local swelling from the site of the bite.
- Early tender enlargement of local lymph nodes, indicating spread of venom in the lymphatic system.
- Early systemic symptoms: collapse (hypotension, shock), nausea, vomiting, diarrhoea, severe headache, "heaviness" of the eyelids, inappropriate (pathological) drowsiness or early ptosis/ophthalmoplegia.
- Early spontaneous systemic bleeding.
- Passage of dark brown/black urine.

Observe every case of alleged snake bite for at least 24 hours before discharging.

1. Check for and monitor the following:
   a. Pulse rate, respiratory rate, blood pressure and WBC count every hour.
   b. Blood urea, creatinine, WBC count.
   c. Urine output, urine for RBCs (in case of Viper bite).
   d. Vomiting, diarrhoea, abnormal bleeds.
   e. Extent of local swelling and necrosis. ECG, arterial blood gas analysis, BT, CT, PTT (to be repeated 6 hourly, if abnormal).
2. Antivenom therapy. Do not administer antivenom as a routine measure in every case of snake bite. It is associated with serious risks of anaphylaxis. It should be given only when features of systemic envenomation are present and in case of local swelling involving more than half of the bitten limb (in the absence of a tourniquet) within 48 hours of the bite, swelling after bites on the digits (toes and especially fingers), rapid extension of swelling (beyond the wrist or ankle within a few hours of bite on the hands or feet), development of an enlarged tender lymph node draining the bitten limb.
   It is most effective in the first few hours after the bite, may reverse systemic envenoming even when this has persisted for several days or, in the case of haemostatic abnormalities, for two or more weeks. The lyophilized powder is dissolved in distilled water or normal saline to make a clear solution before use.
   Note: Polyvalent antivenom is the one available and used in India.
   (**Caution:** Do not use, if reconstituted solution is opaque to any extent).

Dosage regimen

Dose of antivenom varies from case to case. A rough guideline is as follows:

a. For bites with local swelling but no systemic features: 20-50 ml.
b. If the swelling has progressed beyond the bitten site and there are mild systemic features or bleeding diathesis: 50 to 100 ml.
c. If there are marked local and systemic features with haemolysis, clotting abnormalities, etc.: 100-150 ml.
d. Children also be given exactly the same dose of antivenom as adults.

Inj. Hydrocortisone 200 mg and pheniramine maleate 22.75 mg should be given prior to the administration of antivenom in high-risk cases (hypersensitivity to animal serum such as equine antivenom, tetanus-immune globulin or rabies-immune globulin in past, severe atopic conditions and should be given antivenom only if they have signs of systemic envenoming).

Procedure of antivenom therapy

Reconstituted freeze-dried antivenom or neat liquid antivenom is given by slow intravenous injection (not more than 2 ml/minute).

Or

Reconstituted freeze-dried or neat liquid antivenom is diluted in approximately 5-10 ml of isotonic fluid per kg body weight (i.e. 250-500 ml of isotonic saline or 5% dextrose in the case of an adult patient) and is infused at a constant rate over a period of about one hour. All patients should be watched carefully for two hours after the completion of antivenom administration.

Persistence or recurrence of blood incoagulability after 6 hours or of bleeding after 1-2 hours or deteriorating neurotoxic or cardiovascular signs after 1-2 hours repeat the initial dose.

(**Caution**: Antivenom must NEVER be given by the IM route, if it could be given intravenously. Antivenom should never be injected into the gluteal region (upper outer quadrant of the buttock) as absorption is exceptionally slow and unreliable and there is always the danger of sciatic nerve damage, when the injection is given by an inexperienced operator. Do not inject the antivenom locally at the bite site since it is not effective).

At the earliest sign of a reaction: Antivenom administration must be temporarily suspended; keep Epinephrine (adrenaline) (0.1% solution, 1 in 1,000, 1 mg/ml). ready *Skin/conjunctival hypersensitivity testing does not reliably predict early or late antivenom reactions and is not recommended.*

In patients envenomed by vipers, after an initial response to antivenom (cessation of bleeding, restoration of blood coagulability) signs of systemic envenoming may recur within 24-48 hours.

Conservative treatment, when antivenom is NOT available or run out or where the bite is known to have been inflicted by a species against whose venom there is no available specific antivenom.

Neurotoxic envenoming with respiratory paralysis: Assisted ventilation with room air or oxygen has been followed by complete recovery, even after being maintained for periods of more than one month. Manual ventilation (anaesthetic bag) by relays of doctors, medical students, relatives and nurses has been effective where no mechanical ventilator was available. Administer anticholinesterases, Inj. Neostigmine 0.56 mg half hourly, if there are signs of neuroparalysis. Give Inj. Atropine 0.6 mg IV before every injection of neostigmine to block its muscarinic side effects. Oxygen, assisted ventilation, etc. if there is respiratory failure.

Haemostatic abnormalities: Strict bed rest to avoid even minor trauma; transfusion of clotting factors and platelets; ideally, fresh frozen plasma (FFP) and cryoprecipitate with platelet concentrates or, if these are not available, fresh whole blood. Avoid intramuscular injections.

Shock, myocardial damage: Correct hypovolaemia with colloid/crystalloids, controlled by observation of the central venous pressure. Ancillary pressor drugs (dopamine or epinephrine-adrenaline) may also be needed (for details see section on Shock). Treat patients with hypotension associated with bradycardia with atropine.

Acute kidney injury: Conservative treatment or dialysis.

Dark brown urine (myoglobinuria or haemoglobinuria): Correct hypovolaemia with intravenous fluid, correct acidosis with a slow intravenous infusion of 50-100 mmol of sodium bicarbonate and, by analogy with crush syndrome, consider a single infusion of 20% mannitol 200 ml intravenously over 20 minutes. Must not be repeated as there is a danger of inducing dangerous fluid and electrolyte imbalance.

Severe local envenoming: Local necrosis, intracompartmental syndromes and even thrombosis of major vessels is more likely in patients who cannot be treated with antivenom. Surgical intervention may be needed but the risks of surgery in a patient with consumption coagulopathy, thrombocytopenia and enhanced fibrinolysis must be balanced against the life-threatening complications of local envenoming. Give prophylactic broad-spectrum antimicrobial treatment

Other measures

1. Clean the bitten site with povidone-iodine solution, but do not apply any dressings.
2. Leave blisters alone. They will break spontaneously and heal. If there is local necrosis, excise and apply saline dressings. Surgical decompression may be necessary in some cases.
3. Tetanus toxoid injection must always be given.
4. Prophylactic antibiotic.
5. Aspirin or other mild analgesic for pain.
6. Diazepam 5-10 mg for sedation in some cases.
7. Rehydration and nutrition.

Observation of the response to adequate dose of antivenom

- The patient feels better. Nausea, headache and generalised aches and pains may disappear very quickly. This may be partly attributable to a placebo effect.
- Spontaneous systemic bleeding (e.g. from the gums) usually stops within 15-30 minutes.
- Blood coagulability (as measured by 20WBCT) usually restored in 3-9 hours. Bleeding from new and partly healed wounds usually stops much sooner than this.
- In shocked patients: Blood pressure may increase within the first 30-60 minutes and arrhythmias such as sinus bradycardia may resolve.
- Neurotoxic envenoming of the post-synaptic type (cobra bites) may begin to improve as early as 30 minutes after antivenom, but usually takes several hours. Envenoming with presynaptic toxins (kraits and sea snakes) will not respond in this way.
- Active haemolysis and rhabdomyolysis may cease within a few hours and the urine returns to its normal colour.

Management of venom ophthalmia

1. Urgent decontamination by copious irrigation
2. Instil topical 0.5% adrenaline in the eye
3. Topical administration of local anaesthetics—tetracaine)
4. Exclude corneal abrasions by fluorescein staining with a slit-lamp examination and application of prophylactic topical antibiotics
5. Prevent posterior synechiae, ciliary spasm and discomfort with topical cycloplegics
6. Antihistamines in case of allergic keratoconjunctivitis.

   Topical or intravenous antivenom and topical corticosteroids are contraindicated.

References

1. Poisoning, and Drug Over dosage. In: Harrison's Principles of Internal Medicine. Fauci, Braunwald, Kasper et al (eds), 18th Edition, McGraw Hill Company Inc., New York, 2012; pp E281-E296.
3. Common Paediatric Emergencies. In: Postgraduate Institute of Medical Education and Research, Chandigarh, pp 53-70.
4. Disorders caused by Reptile Bites and Marine Animal Exposures. In: Harrison's Principles of Internal Medicine. Fauci, Braunwald, Kasper et al (eds), 18th Edition, McGraw Hill Company Inc., New York, 2012; pp 3566-3576.
5. David A Warrell. Guideline for Management of Snake Bite. World health Organization 2010.

ANIMAL BITES

Bites of squirrels, hamsters, guinea-pigs, gerbils, chipmunks, rats, mice, other rodents, rabbits and hares almost never require anti-rabies treatment.

DOG BITES (RABIES)

Rabies can be transmitted by dog bites or licks of rabid animals on abraded skin and intact mucosa. Other animals which can transmit rabies are cat, monkey, horse, sheep, goat, mongoose, jackal, fox, hyena and bat. Exposure to rodents, rabbits and hares seldom, if requires specific anti-rabies treatment.

SALIENT FEATURES

- Prodromal symptoms—such as headache, malaise, sore throat and fever last about 3-4 days. Pain and tingling at the bitten site.
- Stage of excitation—patient is intolerant to noise, bright light or a cold draught. Aerophobia may be present. Hydrophobia is a characteristic symptom of rabies. Examination shows increased reflexes, dilatation of pupils, increased sweating, lacrimation and salivation. Mental changes include fear of death, anger, irritability and depression. Convulsions may occur resulting in death.
- The last stage is that of paralysis and coma. The total duration of illness lasts for 2-3 days.

A. Treatment (post-exposure prophylaxis)

The WHO recommended classification (Table 2.12) of animal bite for post-exposure treatment should be followed. Every instance of human exposure to a suspected rabid or wild animal must be treated as a category III. The post-exposure treatment is a three-pronged approach. All three carry equal importance and should be done simultaneously:

1. Management of wound: Immediate washing of the wound is a priority. Wound toilet must be done even if several hours or days have elapsed. The wound is immediately flushed and washed with plenty of soap and water (avoid direct touching of wounds with bare hands). Punctured wounds should be irrigated with the help of catheters followed by, 70% alcohol or povidone iodine application.

The application of irritants (like chillies, oil, turmeric, lime, salt, etc.) is unnecessary and damaging.

Do not suture bite wounds immediately. If suturing is required, hold it for 24-48 hours, applying minimum number of stitches under the cover of antirabies immunoglobulin locally.

2. Passive immunization with **rabies immunoglobulin** (RIG): Local infiltration of RIG in category III rabies—RIG should be infiltered in the depth and around the wound even if the lesion has begun to heal followed by administration of antirabies vaccine.

(**Caution**: RIG should never be administered in the same syringe or at the same anatomical site as vaccine).

3. Active immunization with **antirabies vaccine:** Human Diploid Cell vaccine (HDCV)/Purified Chick Embryo Cell Vaccine (PCEC)/Purified Vero Cell Rabies Vaccine (PVRV).

Antitetanus treatment can be given after local wound treatment.

Table 2.12. WHO guide to post-exposure treatment against rabies

Category	Type of contact with a suspect or confirmed rabid domestic or wild[a] animal, or animal unavailable for observation	Type of exposure	Recommended treatment
I	Touching or feeding of animals Licks of intact skin	None	None, if reliable case history is available
II	Nibbling of uncovered skin Minor scratches or abrasions without bleeding	Minor	• Wound management: Administer vaccine immediately[b]. Stop treatment, if animal (dog or cat only) remains healthy throughout an observation period[c] of 10 days[c] or if animal is killed humanely and found to be negative for rabies by appropriate laboratory techniques
III	Licks on broken skin Single or multiple transdermal bites or scratches Contamination of mucous membrane with saliva (i.e. licks) Bite with bleeding	Severe	• Wound management Administer rabies immunoglobulin and vaccine immediately

(a) Exposure to rodents, rabbits and hares seldom, if ever, requires specific antirabies treatment.

(b) If an apparently healthy dog or cat in or from a low-risk area is placed under observation, the situation may warrant delaying initiation of treatment.

(c) This observation period applies only to dogs and cats. Except in the case of threatened or endangered species, other domestic and wild animals suspected as rabid should be killed humanely and their tissues examined using appropriate laboratory techniques.

Doses of rabies immunoglobulin (IG)

Human rabies immunoglobulin (HRIG) 20 IU/kg (max 1500 IU), available in concentration of 150 IU/ml, it does not require any prior sensitivity testing. SHOULD NEVER BE INJECTED INTRAVENOUSLY. The antirabies sera should always be brought to room temperature (20-25°C) before use.

Or

Equine antirabies serum (ERIG) 40 IU/kg (max 3000 IU), available in concentration of 300 IU/ml, given after prior skin sensitivity testing, single dose on day 0. Half the dose is infiltrated around the bitten wound and the rest is given 1M.

(**Caution:** A negative skin test must never reassure the physician that no anaphylactic reaction will occur. Avoid alcohol, glucocorticoids and chloroquine during vaccination; avoid multiple needle injections into the wound.

Must not exceed the total recommended dose of IG as it may reduce the efficacy of the vaccine).

If the calculated dose of IG is insufficient to cover infiltration in all wounds, sterile saline can be used to dilute 2 or 3 fold to permit thorough infiltration. *RIG is not indicated beyond the seventh day* after administration of the first dose of vaccine.

Antirabies vaccine (ARV)

Intramuscular schedule. The course for post-exposure prophylaxis consists of five injections (days 0, 3, 7, 14 and 28) irrespective of severity of exposure. The 6th injection (day 90) is optional for immunologically deficient and extremes of age and on steroid therapy. The dose of vaccine per injection is 2.5 IU/dose/ml for HDCV and PCEC vaccines and 0.5 ml for PVRV irrespective of age and weight of vaccine. Preferable site is deltoid; anterolateral thigh in children (**Caution:** Must NOT be given into gluteus muscle).

Intradermal (ID) schedule. The same vaccine is used approved by DCGI for ID administration as per following schedule:

(i) The 2 site ID TRC schedule (2-2-2-0-1-1) to be administered: One ID injection of 0.1 ml per ID site over each right and left deltoid on days 0, 3, 7 and 0.1 ml at a single site on days 28 and 90 or as per updated TRC schedule (2-2-2-0-2) on days 0, 3, 7 and 28.

Note: *Correct ID injection should result in a raised papule with an orange peel appearance. If a papule is not observed, the needle should be withdrawn and vaccine re-administered correctly nearby.*

(ii) The 8-site ID method (8-0-4-0-1-1) for use with HDC/PCECV in emergency, when no RIG is available.

The intradermal route is preferred as it reduces cost but must not be used in case of immunocompromised patients, individuals receiving long-term corticosteroids or other immunosuppressive therapy or chloroquine.

Antirabies vaccine should be kept and transported at a temperature range of +2°C to 8°C. The reconstituted vaccine should be used immediately or within 6-8 hours of reconstitution.

B. Post-exposure treatment of persons previously vaccinated

Managing re-exposure following post-exposure treatment with nervous tissue vaccine (NTV)

Persons who have received full post-exposure treatment with NTV should be considered as a fresh case and may be given treatment as per merits of the case. If within 6 months, a patient of category I has been exposed to a category II or category III wound, a full course of that type of exposure is indicated. However, if the patient has been treated earlier for a category II or category III exposure and the next exposure is also of same class, only two boosters of ARV 0.5 ml/1 ml intramuscularly or 0.1 ml at 1 site intradermally on day 0 and 3.

Managing re-exposure following post-exposure treatment with tissue culture vaccine (TCV)

If re-exposed, persons who have previously received full post-exposure treatment with a potent cell-culture vaccine should be given only two booster doses, intramuscularly (0.5 ml/1 ml)/intradermally (0.1 ml at 1 site) on days 0 and 3, but no rabies immunoglobulin. Proper wound toilet should be done.

C. Pre-exposure prophylaxis

Indications: Laboratory staff working with rabies virus, veterinarians, animal handlers and wildlife officers. Three full IM or ID doses of tissue culture vaccine given on days 0, 7, and 28.

Laboratory staff and others at high continuing risk of exposure should have their neutralizing antibody titer checked every 6 months. If it is less than 0.5 IU/ml, a booster dose of vaccine should be given. Such individuals on getting exposed to rabies virus after successful pre-exposure immunization require only two booster injections of vaccine given on days 0 and 3 without any antirabies serum/RIGs.

Patient education

- Dog bite (category II and III) is an emergency and as a general rule rabies post-exposure treatment should not be delayed or deferred.
- Immediate washing/flushing with plenty of water and disinfecting with alcohol/iodine.

References

1. Rabies Virus and other Rhabdovirus Infections. In: Harrison's Principles of Internal Medicine. Fauci, Braunwald, Kasper et al (eds), 18th Edition, McGraw Hill Company Inc., New York, 2012; pp 1611-1617.
2. National Guidelines for Rabies Prophylaxis and Intradermal Administration of cell culture Rabies Vaccines. National Institute of Communicable Diseases. Directorate General of Health Services. Government of India; 2007.
3. Rabies Pre and Post-exposure Treatment in Humans. World Health Organization Department of Communicable Disease Surveillance and Response. November 2002.
   Rabies Fact Sheet N°99. World Health Organization. Revised 2006.

INSECT AND ARACHNID BITES AND STINGS CAUSING SKIN DISEASES

Mosquitoes and other biting flies

Most insect bites and stings cause small reactions that are confined to the area of the bite (localised reactions). They can usually be treated at home.

Besides being vectors of several most important parasitic diseases, including malaria, leishmaniasis, onchocerciasis and filariasis, mosquitoes and other biting flies can induce florid local lesions in susceptible persons.

Treatment (for papular urticaria)

1. Tab. Cetirizine 10 mg once daily to relieve pruritus.
2. Topical antimicrobial preparation to prevent secondary bacterial infection (see section on pyogenic skin infections).

Bees, wasps, hornets and ants

Bees, wasps, hornets and ants are species of *Hymenoptera*. Remove the sting and the venomous sac, if it has been left in the skin immediately by scraping it out, either with fingernails or using something with a hard edge, such as a bank card.

(**Caution**: Do not puncture the venomous sac or pinch the sting out with your fingers or a pair of tweezers).

Wasps and hornets do not usually leave the sting behind, so could sting again so leave the room calmly.

Treatment

Most insect bites and stings cause itching and swelling that usually clears up within several hours.

For minor bites and stings:

1. Wash the affected area with soap and water.
2. Place a cold compress (a flannel or cloth cooled with cold water) over the affected area to reduce swelling.
3. Do not burst the blister or scratch the area because it can become infected.

If the bite or sting is painful or swollen:

1. Topical administration of ice pack or calamine lotion for symptomatic relief.
2. Systemic antihistamines and analgesics can be given to relieve pruritus or pain.
3. Systemic corticosteroids may be appropriate, if there are severe side effects.

Any person who collapses, or who complains of wheezing, feeling of anxiety or faintness, generalized itching, or tightness in the chest within approximately 1 hour of being stung by an insect should be treated as having anaphylactic shock (see section on Anaphylactic Shock).

Inj. Adrenaline 1 mg (as hydrogen tartrate) 0.5-1.0 ml IM injection of Adrenaline (1:1000 solution) repeated every 15-20 min, if required.

All patients should be observed at least for 24 hours for recurrent anaphylaxis. (For details see section on Anaphylaxis).

Scorpions

Treatment

1. Simple analgesics, such as paracetamol and aspirin, can be given to relieve pain. However, because of the potential for severe reactions, every effort should be made to get the patient to a hospital as soon as possible.
2. Vasodilators, administered in a hospital setting within 24 hours of the attack, may attenuate the cardiovascular response and possibly reduce mortality.
3. In endemic area, species-specific antiscorpions sera may be available locally and this can be of value, if administered within few hours.

Poisonous spiders

Poisonous spiders are endemic in the tropics and the southern hemisphere where they typically inhabit woodpiles, outhouses and dark corners of garages and houses.

Treatment

1. Specific antivenoms.
2. Analgesics.
3. Muscle relaxants should be given to relieve pain and muscular spasms.
4. Oral corticosteroids, if administered within 24 hours of the attack, may reduce the risk of local necrosis and the incidence of disfiguring scars.

Reference

1. Insect bites and stings – Treatment. http://www.nhs.uk/Conditions/Bites-insect/Pages/Treatment.aspx accessed on 18.9.12.